The Philadelphia Exhaust Ventilator Co.

Ventilating, Heating, and Drying.

121 North Fourth Street,
Philadelphia, Pa.

FOURTH EDITION.

THE

Philadelphia Exhaust Ventilator Co.

MANUFACTURERS OF THE

BLACKMAN EXHAUST WHEEL

AND

BLOWER.

CONSTRUCTED ON AN ENTIRELY NEW PRINCIPLE.

CORRESPONDENCE SOLICITED AS TO ANY FORM OF MECHANICAL AIR MOVEMENT.

THE PHILADELPHIA EXHAUST VENTILATOR CO.,

No. 121 North Fourth Street,

L. G. FISHER, Jr., President.
JNO. P. ONDERDONK, Secretary.

PHILADELPHIA, PA.

CHAS. S. ONDERDONK,
Treasurer and General Manager.

THE EXHAUST VENTILATOR CO.,
116 Dearborn St., Chicago.

NEW YORK EXHAUST VENTILATOR CO.,
45 Fulton St., New York City.

THE BLACKMAN AIR PROPELLOR VENTILATING CO., Limited.
57 Fore St., London, E. C.

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THE BLACKMAN

EXHAUST WHEEL AND AIR PROPELLOR.

AIR CURRENTS.

Without entering upon a full statement of the causes modifying the amount of air required, the effects of air currents demand a brief notice.

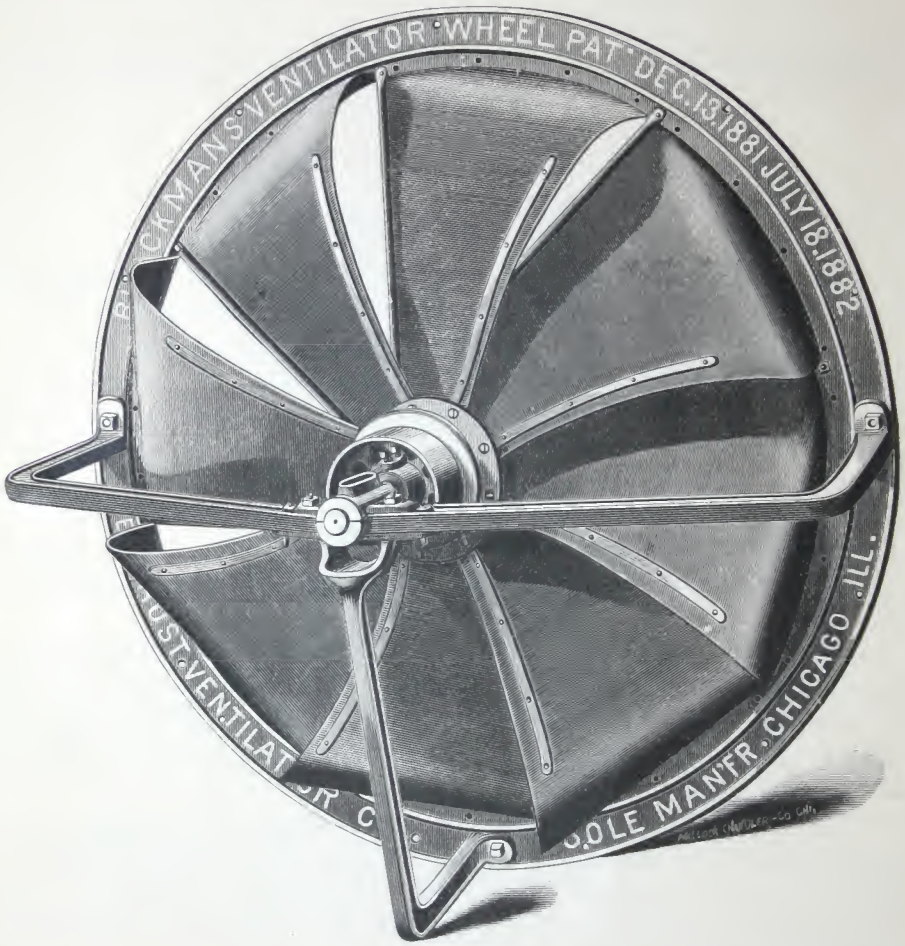
Air under ordinary conditions, in all climates not tropical, will exert a cooling effect upon the system, its temperature being lower than that of the body. If the air be stagnant, little effect is produced, because only a small quantity of air comes in contact with the body in a given time. Increase the velocity, and many small quantities of air coming in contact with the body, more heat is withdrawn. An atmosphere, therefore, that is sultry and oppressive may be rendered cool and refreshing by creating in it a current, provided, always, that the temperature of the air is below 100 degrees.

This result may be reached by the BLACKMAN AIR PROPELLOR, in a manner which will be thoroughly explained in these pages, and it will be seen that its use solves the problem of how to obtain comfort during hot weather; as it creates a cooling breeze by moving the air with sufficient velocity for the purpose required.

There is often a prejudice found to exist in people's minds against ventilation, because of the supposed harmful influence of any draught whatever; while the truth is, that air currents are of themselves harmless if kept within bounds, and that exposure at times to even strong currents will cause no harm to a body properly cared for.

The undue heating noticed so often in improperly ventilated rooms, is quite as dangerous as undue cooling. The trouble caused by really dangerous draughts is often the fault of carelessness that does not attend to crevices around doors and windows.—those irregular, uncertain channels, varying so with every change in the external atmosphere. These are the sources of offensive draughts, and the true causes of colds, inflammation and rheumatism, so fatal and so dreaded.

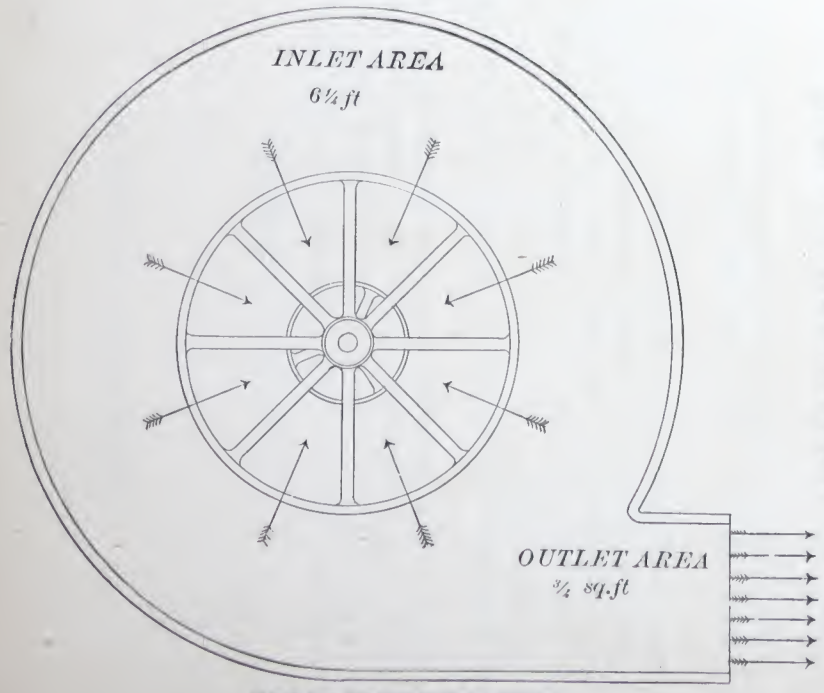
THE BLACKMAN EXHAUST WHEEL AND AIR PROPELLOR.



SIZE	Area of a Circle of same Diameter.	Blackman's Feed Area due to Peripheral Flange.	SIZE.	Area of a Circle of same Diameter.	Blackman's Feed Area due to Peripheral Flange.
12 inch	0.78 sq. ft	1.30 sq. ft.	5 feet	19.64 sq. ft.	32.73 sq. ft.
18 "	1.77 " "	2.95 " "	6 "	28.27 " "	47.12 " "
24 "	3.14 " "	5.23 " "	7 "	38.48 " "	64.15 " "
30 "	4.91 " "	8.18 " "	8 "	50.27 " "	83.78 " "
36 "	7.06 " "	11.78 " "	9 "	63.62 " "	106.03 " "
42 "	9.62 " "	16.05 " "	10 "	78.54 " "	130.90 " "
48 "	12.57 " "	20.95 " "			

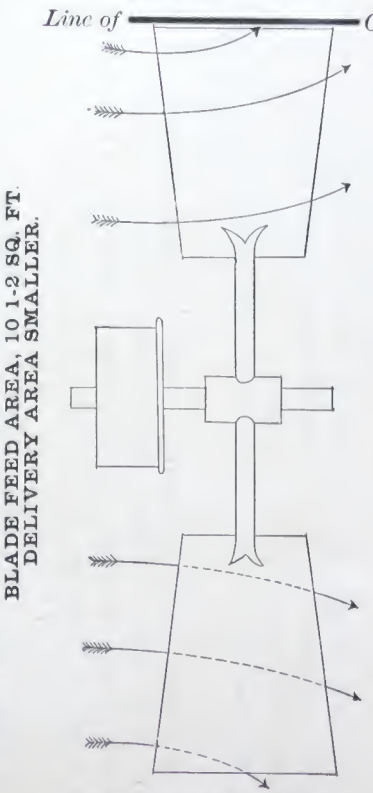
EXAMPLES.

BLAST FAN.



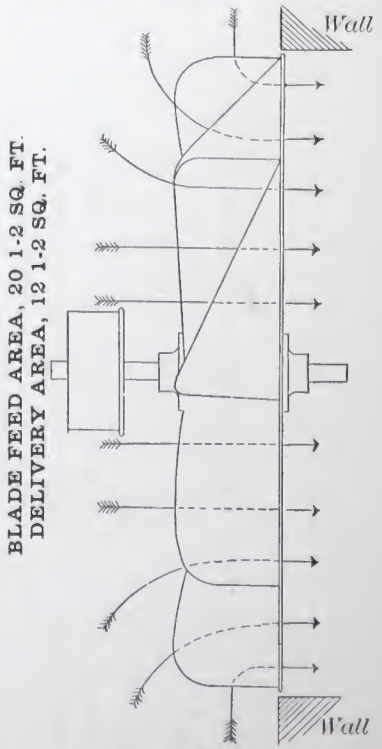
GREAT CONCENTRATION,
SMALL VOLUME.

OLD FORM OF FAN.



NO CONCENTRATION,
FAIR VOLUME.

BLACKMAN'S IMPROVEM'TS.



FAIR CONCENTRATION,
GREATEST VOLUME.

By reference to these diagrams a better understanding of the explanation of mechanical air movement (given in the next pages) is afforded.

GENERAL PRINCIPLES.

A submarine diver, one hundred feet under water, must have an air-moving machine that can force a small volume of air down to him with a force or pressure in excess of the pressure of the column of water above him. In this case the requirements are a *very small volume under a very great pressure.*

The machine room of a paper mill should have an air-moving machine to carry off the very large volume of steam or moisture generated in the drying of the paper as it passes over the steam cylinders. It is apparent that here there is but a very slight pressure or concentration, as the work to be done is to throw the steam and wet air out of a window or out through the roof. In this case the requirements are the *very largest volume and a very low concentration or pressure.*

The machine that keeps the diver alive could not keep the paper mill dry, neither could the machine that keeps the paper mill dry keep the diver alive.

These extreme examples are chosen because of their simplicity and plainness to all.

That the methods of air movement, so essential and important in sanitary ventilation and economical in various processes of manufacture, have not been heretofore greatly improved, has been due to the use of incorrect forms of air-moving machines, and to absence of expert ability in pneumatic engineering.

BLAST FANS, and all forms of air movers in which there are small entrance and exit openings, are intended for high pressure and small volume, and their field of usefulness is where the volume needed is small and the pressure or resistance great,—for example, driving air into a blast furnace, or ventilation of a deep mine.

Nearly all of the many forms of fans constructed on the principle of the screw propellor of a steamship are intended for large volume, but their very open form of construction, made in the effort to obtain large volume, has almost totally deprived them of any suction or blast, concentration or pressure ability. Thus, while they may disturb large volumes of air in their immediate neighborhood, they like their prototype, the screw of a steamship, which if revolved too fast will only "churn" and not push forward the ship, could not overcome the slight resistance met with in all practical work.

The main reason why the old forms of volume fans lack forcing ability is, that when any resistance is encountered, the forward movement of air through the fan is at once checked, and a current of air flows back through the center. Under these conditions, a small portion of the fan near the rim is driving forward air, which is immediately brought back by the strong back-draft through two-thirds of the face of the fan, thus creating a circular current, but not moving any air forward against the resistance. All efforts at construction heretofore, which have resulted in giving the fan a fixed and positive hold of the air once it had entered the fan, have resulted in lessening the feed or delivery areas, and so reduced the volume almost to the level of a blast fan.

The Blackman inventions have resulted in a form of blade which delivers the maximum amount of air, and in a form of construction which gives a FEED AREA some 66⅔ per cent. greater than that of the old forms. The result of this is, the fans or air propellors made by this Company give the *largest volume* at the *least horse-power*.

Except in the proper field of the blast fans, the Blackman Fan has successfully accomplished all forms of practical air movement, and is daily opening new fields which heretofore could not be worked economically.

By the use of our methods in various manufacturing industries a better grade of product can be obtained, a saving of time effected, and in many cases the health of the workmen improved. See lists, pages 45 *et seq.*

Before speaking briefly of individual uses of wheels, we would respectfully ask the reader to again refer to page 5, hoping that a short study of the diagram will convince him that past failure of old forms is no argument against the success of the Blackman, but that the improvements embodied in the Blackman are evidence of the great advancement in mechanical air movement claimed by this company.

While we make a special feature of the Blackman Fans, experience having shown that they cover the largest field, still, as has been stated in the previous article, there are uses for which other forms are best, particularly and almost only where high pressure is required and no need for large volume exists.

Besides carrying a large stock of fans of our own manufacture, we are prepared to supply any form of machine for mechanical air movement, including pressure or blast fans.

USES OF THE BLACKMAN WHEEL.

VENTILATION OF DWELLINGS AND OFFICES.

Ventilation consists essentially in the introduction of pure, and the removal of vitiated, air.

The question, then, of primary importance is the number and position of the entrances and exits for air. In regard to the number of flues necessary, there exists one very popular and widespread error. Air will not move unless impelled; and unless a new portion of air be admitted, the air already in the room cannot be expelled. The apparent exceptions are due to the fact that in the majority of houses, if not in all, doors and windows at all times furnish admission to the external air in variable proportions. Two openings are therefore necessary; and in every case these must have free access, both to the room and to the external air, in order to fully serve their purposes. This will partly explain the defective ventilation so often noticed in churches and assembly rooms, where the discharge flue provided is found to be but a blind opening leading to a closed space beneath the roof.

The flues and apertures must be of adequate size, for air, although perfectly elastic, requires space for free movement; and an opening which is too small is but little better than none. The location of the openings should be determined by the needs of the occupants of the room, the position of the heating and lighting apparatus, the arrangement of doors, windows, etc. The exit should not be, under any circumstances, on the same side as the inlet, as then the circulation would be from one opening to the other, and would affect but a small part of the room. As to whether the air should be admitted at the top of the room or not is a question upon which much difference of opinion has been expressed; but our experience seems to prove that it is better to admit fresh air near the top, and remove the foul air from the bottom. Under some circumstances this arrangement would not be desirable, and then the up-draft system should be applied.

Another question of great importance is the course the air ought to take in passing through any apartment. This leads us to a brief discussion of the different methods of ventilation.

Since the air currents are produced in the natural atmosphere by heat, the application of the same cause to produce movements has been named by the advocates of the system, Natural Ventilation. The air inhaled by the lungs at the temperature of the surrounding atmosphere is always

exhaled at the temperature of 98 degrees. At the same time, the air in contact with the body, becoming warmed, ascends, and thus creates a certain movement in the air surrounding the individual. No ventilation other than is thus afforded would be needed by an individual in the open air. But cover the body with clothing, place it in a crowded room, supply a number of lights and the heat of a furnace or stove, and with every addition, with every change in the condition of the atmosphere as to heat, moisture and prevailing winds, and the problem becomes exceedingly complicated. It is because of such complications that all methods of ventilation, which are classed as natural, be they expensive or the reverse, fail to solve the problem in a satisfactory manner.

All methods or systems of ventilation depending wholly or in part upon the use of any moving mechanism are called *mechanical.* The machines used may be broadly classed as pumps or fans, and the methods as *filling* and *emptying*, or *plenum* and *vacuum.* In the plenum method, fresh air is forced in at the proper temperature, and by filling the building to overflowing with pure air the impure air is forced out. In this system, as the greater pressure is from the inside of the building or chamber, the opening of a door or window is followed by an outward flow of air, thus avoiding the inrush of cold air, so often the cause of serious results.

In the exhaust or vacuum system, the air is removed from the room or building, causing a less air pressure within than is normal without, and the air enters because of this excessive outside pressure. This system is very efficient and desirable in all summer ventilation, or where cooling is the object desired. The ventilation of a chamber or building by either system permits a change from one to the other, so that by driving in air a plenum can be maintained, while by reversing the fans or air propellors, and drawing the air out, a partial vacuum can be formed. In particular cases a combination of both systems may be needed to produce the best results.

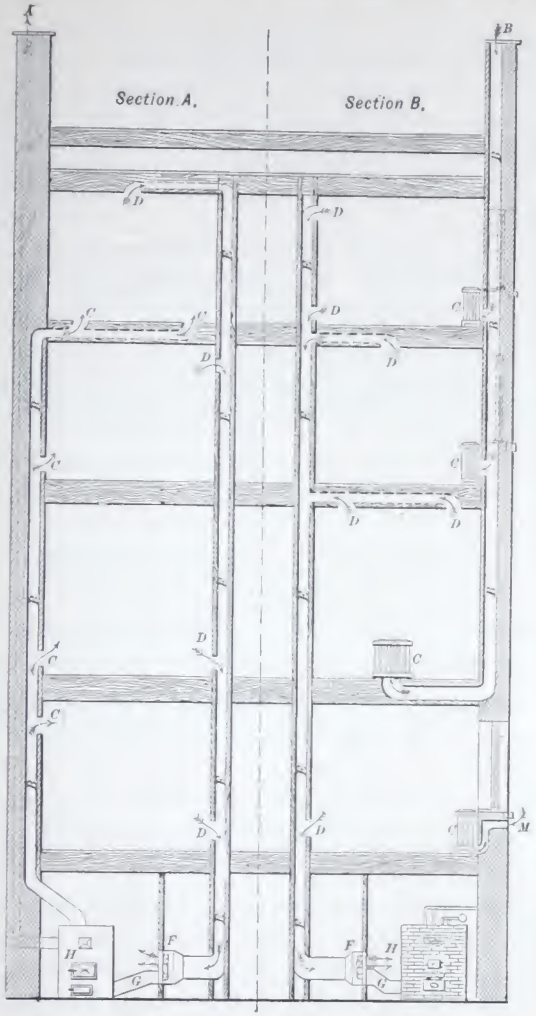
This subject is more fully treated under the head of Ventilation, to which the reader is referred.

VENTILATION OF PUBLIC BUILDINGS.

In the ventilation of large public buildings, special means must be contrived for the handling of large volumes of air, and for this reason the system of ventilation should be embodied in the plans of the building. In the Chicago Board of Trade Building, lately ventilated by this company, a combination of both plenum and vacuum systems is applied. The fresh air is taken from two points above the street, one at the top of the building and the other at openings in the side wall, far above the sidewalk. The supply is drawn down the air-shafts and forced, by means of Blackman Air Propellors, into four systems of piping, from which a branch is taken to each steam coil located in the basement. By passing over these coils the air is warmed, and is then forced up through flues built in the walls, which deliver it into various parts of the building. The foul air is removed by a system of exhaust flues and fans, arranged to work independent of the blast. This system is divided into two distinct and independent parts, which can be worked together or separately. In one the air from the main hall is drawn out at the upper part of the room, through openings in the cornices, and forced out through the roof by the fans. In the other, the exhaust openings are placed near the floor, drawing the foul air from the lower part of the rooms. The latter system is connected with the main hall, the offices, the settling room, etc. In addition to the air supply, which is heated by the indirect system placed in the basement, a large amount of air is admitted through openings in the outside walls, and heated by passing through steam coils placed under the windows. The ducts from the exhaust registers are collected into several large exhaust chambers, from which the air is drawn out by the exhaust fans and forced out into the street.

In the Chicago Opera House, both plenum and exhaust systems are used, and the general current of air is from below upward, and out through the roof. Two fans are used to force air into the buildings, and a third, placed in the roof, exhausts the foul air. As a plenum is maintained inside, the cold draughts from the stage and corridors are prevented, and a constant current is forced out through all openings.

During the New Orleans Exposition, our fans were in use ventilating the Machinery Department in the Main Building. Two were placed on the first floor and two in the gallery, drawing out the heated air and keeping up a constant circulation of fresh air through this department.



EXPLANATION.

Sections A and B illustrate several methods of application of the Exhaust Wheel in the ventilation of public buildings, or of private dwellings where sufficient power can be furnished in basement or cellar.

In section A the supply of pure air drawn through air box of furnace H is delivered heated to each room. By action of Exhaust Wheel F the vitiated air is drawn through apertures D and ducts E, creating sufficient vacuum to compel the steady and full action of hot-air flues. This removes the objection to hot-air furnaces, because whatever the direction and force of the wind, the exhaust impulse given by the wheel will regulate the force of the hot-air current.

The heated impure air passing through the ducts E imparts heat to the walls, thus preventing any waste. The air current forced by fan through pipe G, which may be con-

nected with chimney flue, furnishes sufficient draught at all times. If not needed, the current may be removed by a damper through another exit.

Summer ventilation may be secured,—1st, by connecting air box of furnace directly with flues B, the movement of the air being secured by exhaust of fan; or, 2d, by connecting fan with flues B and reversing the direction of current, the current passing through air box, flues E joined, and entering the room through apertures D, while the exhaust pipe, being connected with flue B, draws the air through apertures C, thence through fan to chimney.

In section B, the pure air drawn through an aperture, placed at some point near or within cornice, is drawn through flue B, is heated to some extent by contact with steam pipes, and enters the rooms back of or beneath the radiators C. The impure air rising is removed through apertures D and flue E, connected with fan F, thence carried through pipe G and flue A or through aperture to outside air.

At M is illustrated one method of securing fresh air by a duct built in the wall, and opening beneath the window sill, by which the air is conducted to the bottom of the radiator, thence into the room.

SANITARY VENTILATION, HEATING AND COOLING.

The successful sanitary ventilation, heating and cooling of buildings has heretofore been difficult and uncertain, for the following reasons:

First.—"Ventilators" placed on the roof or chimney tops, and depending for their operation on the action of the winds, will not act on a quiet day, when most needed.

Second.—Blast Fans, having a high pressure or suction ability, cannot move a sufficient volume, except at such a great expenditure in power and engine and boiler plant as to make the use of them impracticable.

Third.—An adequate and ample volume is obtainable at a cost in plant and power sufficiently low to be feasible with fans constructed on the principle of steamship propellors; but, owing to the lightness of air as compared with water, such forms of fans, when connected with flues and ducts, for the ventilation, heating and cooling of buildings, have been a total failure because of their very low suction and blast powers, for while they can disturb large volumes of free air in their immediate neighborhood, they cannot force or exhaust through a system of flues.

Fourth.—Other forms of movement of air, miscalled natural, automatic or non-mechanical ventilation, are not natural, are not automatic, and are mechanical, being produced under certain laws and facts, by means of the factor Heat, which is equivalent to a certain amount of mechanical work.

In a system of natural ventilation, the inflow of warm air through the registers may be entirely checked by the wind blowing on one side of the

building, and a current of cold air may even be driven down the flues under these circumstances.

In the summer, a system of natural ventilation is almost useless, and as a matter of fact, most buildings which depend in winter upon this system for their supply of fresh air, in summer are compelled to resort to the opening of windows and doors, with all the accompanying discomforts.

We ask your attention to the cuts of our Fan, it being the agent employed by us in the movement of air.

In nine-tenths of the cases where fans are used, considerable resistance, either in suction or blast, must be overcome.

The reason why fans of the propellor-blade type have not succeeded, is mainly because they lack forcing or suction ability. As soon as the air encounters any resistance it is forced back through the centre of the fan, so that only a small volume is moved forward against the resistance. As these fans must be encased in a tube, there is no possibility of there being an inflow of air from the sides.

By a close inspection of cut on page 5, you will appreciate the value of the Peripheral Flange possessed by our fans. It is an entirely new feature in fans. An evidence of its novelty and efficiency is the fact that the countries of the world have recently granted patents on this very feature. The results in obtainable suction or pressure, together with the tremendous volume of air, are as surprising as is the fact that at this late day there should be a discovery in the old subject of fans that is so novel that no country in the world could refer us to a former discovery or use, but, in granting patents, have from the outset admitted its novelty and efficiency.

One horse-power applied to our four-foot Fan will move *one million* cubic feet of air per hour under ordinary circumstances. The handling and delivery of any given quantity of air, in any condition,—heated, cold, dry or moist,—in all seasons and under any atmospheric conditions, can now be undertaken and definitely contracted for.

HEATING.

Ventilation and heating are so intimately related, that this Company will contract for the heating in any and all buildings where it has undertaken the ventilation, or where the owners desire that the same contractor shall undertake both departments.

This Company wishes it to be distinctly understood that it has no special or peculiar way of heating to insist upon. Should its opinion be desired it will give the same fully and freely, conveying what its experience may have shown concerning "down draft," or the introduction of warmed fresh air at the top; "up draft," the reverse of "down draft;" "side introduction," and the plenum and vacuum systems. In buildings already put up, the particulars of construction determine what system is best. In new buildings they may be adapted to any of the many good systems.

Attention is called to the proposition of this Company on page 21.

This Company stands ready to demonstrate to a positive conclusion, that much less steam heating pipe and much less radiating surface is needed to do the same work when air is mechanically forced through the heating surfaces, than when the same coil and heating surface is placed and operated in the usual manner.

Our scientific tests prove, and practice confirms, the claim that mechanical movement of air at proper speeds through heating coil will produce the same result from much less coil than was required in the old systems; the economy is apparent.

As to convenience and economy of placing, under our system the heating surface may be all in one place, and that place any unused room, attic or cellar, and the air, warmed by being forced through the steam coil or radiator, may then be delivered to any part of the building through ducts and flues built in the walls and floors. By keeping up a constant pressure in these ducts there is no possibility of the wind forcing a back current down the flues, or preventing the inflow of fresh air.

VENTILATION OF PUBLIC BUILDINGS.

Our system, as applied to the new Chicago Board of Trade Building (see page 10), will give an idea of what can be accomplished where neither money nor pains are spared to secure the latest and most improved form of apparatus for ventilation and heating. In this particular case our system had to be adapted to foundation and walls already built.

When the system of ventilation is incorporated into the building plans, many of the flues and ducts may be constructed in the walls, floors, etc.

SCHOOLS, HOSPITALS, ETC.

In public schools are daily congregated a large number of children of different ages, in various states of health, and cleanliness. The delicate organizations of children, the dangers of infection from vitiated air, the variations in numbers present, and the ignorance of teachers and janitors, render the thorough, healthful ventilation of a school-room an impossibility by any so-called natural method. That this may not be considered a case of special pleading we subjoin a table taken from examinations made by an expert in the Rochester schools:

TABLE II.

Amount of Air required for each Pupil in different Grades.

GRADE.	Average Age in Years.	Amount of Air for each Pupil per hour in Cubic Feet.	Amount of Air Space for each Pupil in Cubic Ft.
9th	6.26	850	142
8th	7.56	1,050	175
7th	8.66	1,170	195
6th	9.52	1,350	225
5th	10.69	1,440	240
4th	11.72	1,580	263
3d	12.90	1,740	290
2d	13.69	1,850	308
1st	14.88	2,000	333

We have had opportunities of testing the requirements of pupils in poorly ventilated buildings. In particular we noticed in all schools ventilated by the natural method a difference in temperature at different distances from the floor. One large school building, heated by both furnace and steam, was provided with flues passing from basement to cupola.

These flues were carried some distance through a cold garret, and were useless for that reason, since the cold air acted as a perfect damper.

It was noticed that the impure air circulated from the lower room to the one above, or the reverse, as the temperatures differed. The entrances to these flues were near the floor, and were so unsatisfactory that they were finally permanently closed. Standing on the rostrum, the stratum of air breathed by the teacher was heated to 70 degrees, while the lower stratum, breathed by the pupils, was 67 degrees, and that near the floor was 62 degrees to 64 degrees.

In another school, where our system of ventilation has been in use for some time, actual tests show the following conditions existing at the time. The rooms were crowded, and the weather cold and rainy, the exhaust steam from the engine being used for heating. The temperature at the floor level was 64 degrees, two feet above the floor 65½ degrees, and at seven feet 67 degrees, while the velocity of the air going out through the registers averaged eight feet per second. The average amount of carbonic acid was 4¾ parts in 10,000 of air. An hour and a-half after the fans had been shut off a test showed: Temperature at floor 60 degrees, two feet above 62 degrees, and seven feet above 72 degrees, while the proportion of carbonic acid gas had risen to 15 parts in 10,000, three windows being open 10 inches each at the top.

Were the air movement mechanical and positive, any desired condition could be maintained, without regard to outside atmospheric conditions.

In hospitals many of the same conditions exist as in schools, and a system, to be successful, must furnish and remove, under perfect control, a large volume of air with a velocity that can be regulated and so distributed as to supply fresh air to, and remove foul air from, each bed in each ward. Economy of space, economy of fuel, ease and certainty of action, perfect independence of weather, and efficiency in summer and winter alike, are facts that we can demonstrate by the use of our system.

We invite all interested in the subject to examine the merits of our system as applicable to this class of buildings, as the problems presented are identical with those we are daily solving.

Attention is called to the proposition of this company on page 21.

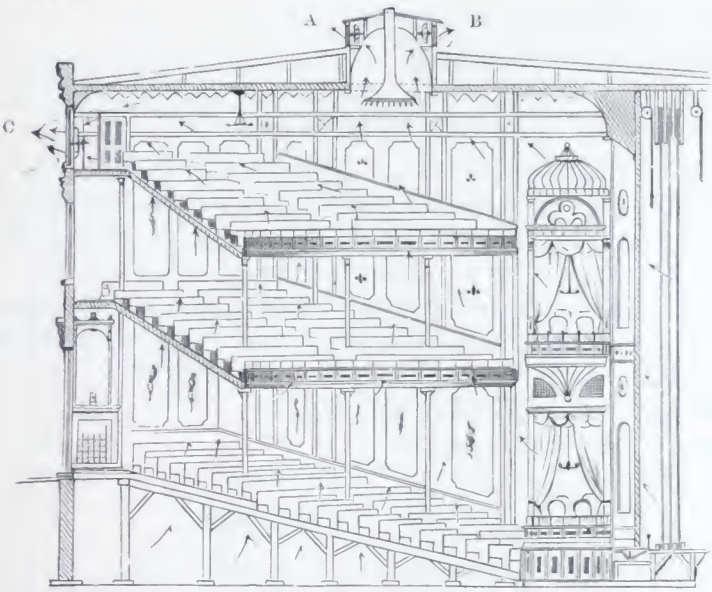
THEATRES, OPERA HOUSES, ETC., ETC.

The ventilation of a theatre is one of the most difficult problems to be found. A theatre consists, not of a single apartment, permanently enclosed like other assembly rooms, nor of several distinct and permanently sepa-

rated rooms like a school, but of three large open parts,—auditorium, stage and corridors,—at one time separate and distinct, at another joined as one. To this difficulty must be added others of even greater force,—the constant shifting of scenery, the movement among the audience, the varying number present, the influence of the lighting, and the acoustic requirements.

Our first-class theatres should be more popular resorts in summer than in winter. On the contrary, it is with extreme difficulty that a summer management can be made to pay. If the temperature within the auditorium could be maintained at a lower point than the temperature without, and at the same time fresh air be furnished in abundance without causing unpleasant draughts, the popular objections would immediately cease.

The following example is of our system, as applied to the Academy of Music, Chicago:



EXHAUST SYSTEM.

Two wheels were placed upon sides of the dome, as indicated by A and B; two wheels were also placed in the upper gallery (one only is represented in the illustration) at C, exhausting directly across the upper section, near the ceiling, and thoroughly ventilating both sections.

The circumstances here warranted the use of the exhaust system. In the Columbia (late Haverly) Theatre, Chicago, the circumstances called for a plenum system, since by the exhaust system there would have been a great inrush of cold air from the doors; but as in the plenum system the

pressure is from within, the opening of a door is followed by an outward escape of air, not felt by the audience.

In the Chicago Opera House the peculiar circumstances require a combination of exhaust and plenum, and in this building we have in certain parts wheels supplying fresh warm or cold air, and in other parts wheels drawing out the vitiated air. In many cases the best arrangement would be the down-draft system, in which the heated air is admitted at the top of the auditorium and drawn downward and out at the floor.

In combination with our ventilating systems, we have air-heating, air-cooling, and drying and moistening devices, and we have, almost to our surprise, found that we could alter temperature at the rate of a degree per minute, which is far in excess of the most exacting requirements we have as yet met.

Please see proposition on page 21.
Volume of air moved, page 38.

MUSEUMS, MUSIC HALLS, ETC.

In museums, particularly those having theatres running all day and night, we have met with great success. In the hottest weather we have kept the temperature as low as outside, and the motion of the air produced a cooling effect.

Kohl & Middleton's Dime Museum, ventilated by this company, has been, in the hottest days and nights of summer, a COOL RESORT both in the museum and theatre.

Please read our proposition on page 21.
Volume of air moved, page 38.

BANKS AND COUNTING-ROOMS.

In banking-rooms particular care should be taken to prevent all draughts and currents of cold air, and yet furnish an abundant supply of fresh air at a proper temperature. By a careful study of the rooms, arrangement of desks, windows, etc., we can devise a system which will result in purity of air, equalization of temperature in summer and winter, and avoidance of draughts. We refer to The Merchants Savings, Loan and Trust Company, and the Commercial National Bank, both of Chicago, as samples of work we have done in this line, and ask attention to our proposition on page 21.

BARNS AND STABLES.

In cities, where many animals are clustered together in barns and stables, it seems odd that the loss in work caused by foul air and poor ventilation has not received greater attention. Generally the introduction of a cheap, simple system of ventilation will remove all foul odors and bad air, and increase the working capacity of the horses.

At the Palmer House Stables,—Leroy Payne, proprietor,—one fan is used to ventilate the stables and carry off the dust from the grooming-stand, and the effect produced is at once apparent.

Please see our proposition, page 21.

Volume of air moved, page 38.

MINES.

A large volume of fresh air is required in a mine. In the older countries mines are generally so deep, and the shafts and tunnels so long and tortuous, that the problem presented is very similar to that of the submarine diver in example on page 6. Where this is the case, air-moving machines giving a great pressure or concentration are the best that can be used. In many cases mines are almost abandoned because only a too small volume can be forced down into them. But in newer countries, many mines are using a high pressure air machine, giving only a small volume, and that at a great cost; when the facts are that large volume Blackman Fans can give more than the needed pressure, and a volume ample in all respects, and at a cost of plant and working power but a fraction of that of the pressure fans.

Having given this subject study and experiment, we can, on examination, tell what form of air machine is best suited for a certain mine.

The ventilation of mines being a large field, we would invite correspondence from mine owners and superintendents.

Volume of air moved, page 38.

STEAMSHIPS, VESSELS AND YACHTS.

The problems presented in this field are not different from those that we are daily solving. The many subdivisions of ocean vessels by bulkheads make the work resemble a long sum in addition,—not deep, difficult or profound, but merely a long sequence of simples. Any one room or section of a vessel we can ventilate fully and perfectly, the cost and difficulty of ventilating the whole vessel depending only on the number of sub-

divisions. We are ventilating cook's galleys, pantrys, dining saloons, cabins, supplying artificial draughts, etc., etc., in vessels.

As each vessel has its own peculiarities, we do not feel that a cut of any of our systems would be of any use, so do not insert one, but would call vessel owners' attention to our proposition on page 21.

Volume of air moved, page 38.

CATHEDRALS, CHAPELS, CHURCHES, HALLS AND SIMILAR PUBLIC BUILDINGS.

Such buildings are sometimes occupied but once a week, and then but a short time. No matter what may be the outside conditions—warm or cold, dry or wet—there is but a short notice given in which to prepare. The audience may be large or small, and this question remains unanswered until the audience is there, and it then demands good ventilation and the proper temperature. This class of buildings seems more than any other to call for a positive mechanical system, with great flexibility, large capacity and speedy results. We ask attention of owners and directors of such buildings to our proposition on page 21.

Volume of air moved, page 38.

RESTAURANTS, HOTELS, EXCHANGES, ETC.

In almost every city in the United States Blackman Fans have been put up in restaurants and kitchens, to carry off the heat from ranges, and prevent the odor of cooking being noticed in the restaurant proper. Where the room is long and narrow, with the kitchen at the end, the problem is very simple, and a steady current of air can be drawn through the restaurant and out through the kitchen, furnishing an abundant supply of fresh air, and preventing any steam or odor escaping into the room from the kitchen. Where the circulation is kept up continuously in this manner the room will in summer be kept entirely free from flies.

We refer the reader to the list of restaurants where our fans are in use, and ask his attention to the results actually accomplished in this field.

SAFETY VAULTS, RECORD ROOMS, ETC.

The peculiar manner in which these buildings are constructed does not allow of any free circulation of air through the rooms; but by an arrangement of independent flues, and the application of our fans to a system as determined by circumstances, perfect ventilation can be maintained at all times.

Please see proposition on page 21.

PROPOSITION.

The need in hydraulics of expert hydraulic engineering is admitted and recognized. Expert ability and special study, information and experience, are equally necessary in the transmission of air, and one of our departments is "pneumatic engineering."

Should owners or architects wish us to figure upon the ventilation of a building, and will submit to us the plans, we will, at our own cost, have our experts draw up a plan showing our system as applied to the particular case, and the price at which we would put in the same, together with results obtainable from it. We are also prepared to furnish full data as to the amount of heating surface required in any building, having found that by means of our fans *the capacity of any given amount of heating surface is greatly increased.* This fact, together with the saving in construction arising from the concentration of all heating surfaces in one place, the increased efficiency in the apparatus, render it the most economical, in point of cost, of any system in existence. We are also prepared to contract for the heating and cooling of buildings.

We claim further for our mechanical system, that it is the only system which can be successfully applied for the ventilation of places of public assembly,—theatres, halls, churches, legislative chambers and exchanges, which are usually crowded with people, and where the quantity of bad air and dust generated has heretofore defied the efforts of all other systems to effectually remove it. It is also elastic, and may be varied to meet the changing requirements of attendance, the quantity of air moved varying with the speed of the fan, which may be increased or diminished at pleasure.

Upon application we will furnish references to buildings ventilated by us and to parties using our wheel. Any plans submitted by us remain the property of this company, and if not accepted must be returned.

DRYING.

This very important part in so many manufacturing processes is a subject surrounded by and conducted with greater ignorance than is any other department or process of equal importance.

Drying is driving the moisture out of the material, *and carrying it off.*

Everybody seeks to drive the moisture out of the article, and upon this point, and this point only, have much thought and money been spent, the efforts in this direction being mainly confined to supplying great heat. After all the moisture that the surrounding air will hold—and it will not hold much—has been driven from the article into the air, but few and insufficient efforts have been made to carry this moisture away, by removing the air which contains it. The result has been that, once the air has received all the moisture it could carry the drying process stopped, or if a drier article was put into that room it would get moist by taking the water from the air that surrounded it.

Air takes up moisture fast at first, but soon gets fully saturated.

Heat is useful to vaporize the water in the article, and the degree of heat is proportionate to the density of the article. In digging a cellar, the shovel (heat) puts the earth into the cart; the cart (air) carries the earth away. You cannot dig a cellar without hauling the earth away.

The most rapid drying results when the greatest volume of fresh air, at the proper temperature, is caused to carry off the moisture as soon as it is released from the article. To deluge the article with large quantities of dry air, even though cool, produces better results than to heat the article very hot when surrounded with air holding all the moisture it can take up.

The resistance from driving or pulling the air through the material is greater than the old forms of volume fans could overcome (see diagram on page 5, and the explanation). Pressure fans, giving only a small volume, have been used. The substitution of the Blackman Volume Fans has resulted in the most astonishing results. Drying processes that formerly took days or hours are completed in a corresponding number of hours or minutes.

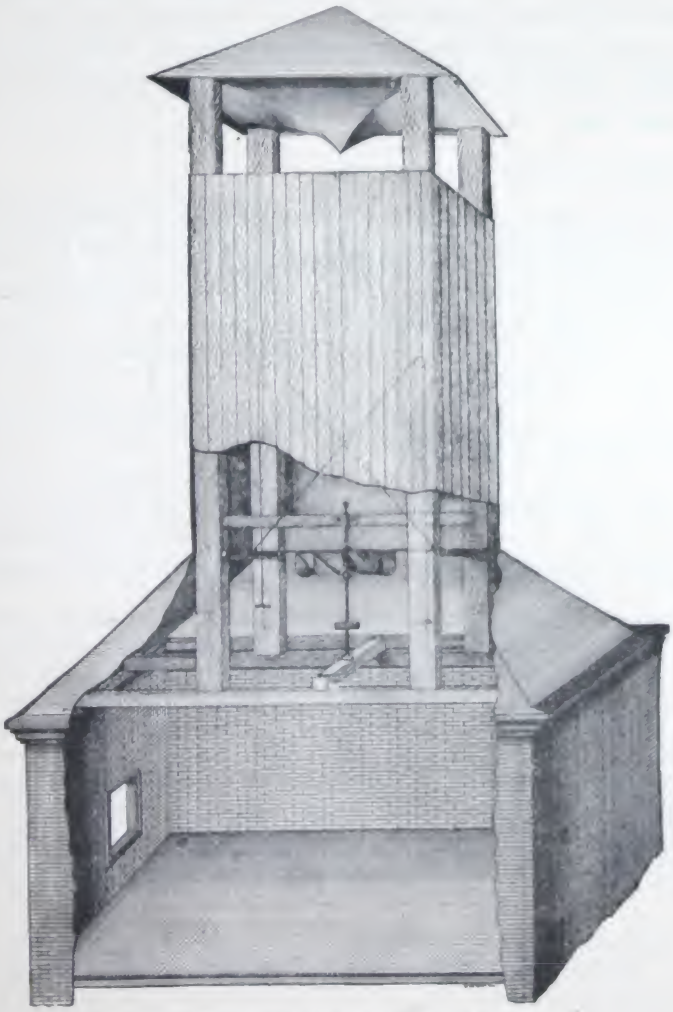
The principles of drying being in all cases the same, as explained above, the efficient or inefficient application of the process depends upon large volumes or small volumes of fresh air being brought into direct contact with the material to be dried, the heat being proportionate.

The method of handling and the form of different materials vary so greatly that, to produce the best results, a drying chamber should be devised

for each substance. But our experience indicates that there are a few general forms which, by slight changes, can be applied to very many articles of the same general description.

The following cuts and explanations cover broad fields, and, by slight changes in construction, the dryer can be changed to a special form, of which it is the general type.

DRYING MALT, CORN, OATMEAL, WOOL (WOOL PULLERS), SEEDS, STARCH, CEREALS, ETC., ETC.



SECTIONAL VIEW OF MALT HOUSE.

Please read article on Drying, on page 22.

All of the above materials are best handled by being placed on perforated floors, the air heated or cooled below and drawn upwards through materials by fans placed above. Experience shows us that a greater quantity of air drawn through at a lower temperature results in more rapid drying, and in many cases the material comes out a better quality. Of all these materials, malt may be considered the most difficult to handle. The process of drying it was the most highly developed process of the kind at the date of the invention of the Blackman Fan. By the proper application of our fan the drying is much improved and we confirm our claims of perfect success, by the following extracts. See list of users page 45 for a party near you, using fans, and we ask your attention to our proposition on page 36.

EXHAUST VENTILATOR CO.,

Gents:—In answer to your inquiry regarding the practical workings of your system of malt house ventilation, I would say that I have given it a thorough trial during the past season, and am highly pleased with the results obtained.

Two of Blackman's 48-inch fans were placed at the base of the cupolas of our two double kilns, one in each, about the first of November last, and have been run daily until the closing of the malting season, June 1st. By careful computation we find that we have made the following saving in coal:

From October 1st, 1881, to June 1st, 1882, before we put the fans in, we used 662 tons of Lackawana coal, and malted 154,306 bushels of barley, or an average of 4 tons and 580 lbs. of coal to 1,000 bushels of malt.

From November 1st, 1882, to June 1st, 1883, after we had put the fans in, we used 456 tons of coal and malted 138,334 bushels, or an average of 3 tons and 592 lbs. of coal to 1,000 bushels of malt. In other words, we have saved by the use of your fans during the season 137½ tons of coal on same quantity of malt, or an average of 1,988 lbs. of coal to 1,000 bushels of malt.

At first the fans were speeded at 600 revolutions per minute, but the draft was too strong, and we have reduced it to about 300 revolutions per minute, with better results.

We run the fans from 8 to 10 hours a day, depending on natural ventilation through the night. We estimate that it takes from 6 to 8 horse-power to run the two fans.

Where we formerly required the services of three men during the night we have now only two, for by the use of the fans the malt requires less turning. When we first put on a fresh kiln we have a very slow fire, and depend almost entirely on the cold air to draw off the moisture. In the coldest weather it takes about three or four hours to draw off all the steam and moisture, and then we fire up and partially close the cold air flues, and finish up with a hot fire and a slower speed of the fans. If we were to run the fans night and day we could dry as much malt on one double kiln as we formerly did on two double kilns.

Each of our kilns contain about 48,000 cubic feet, being 33×26 and 55 feet from furnace to fans. By this process of drying we find the malt comes out paler and more mellow, and is less liable to burn.

We estimate that the saving in coal and labor this first season, to say nothing of the

superior quality of the malt, has been more than sufficient to compensate us for the original outlay.

I take pleasure in recommending your process of malt drying to maltsters as something worthy of their careful investigation, and feel confident that when they are once introduced into a kiln, and given intelligent and careful handling until the knack of running them is acquired, the results obtained will satisfy all interested.

Yours respectfully,

JOHN CARDEN,
Of Bemis & Carden Malting Co.,
CHICAGO, ILL.

"The natural draught is accelerated."
HON. JOHN C. LANGDON, Detroit.

"The draught is more even and entirely independent of the weather."
BEMIS & MCAVOY, Chicago.

"Saves fully twenty-five per cent. in fuel."
BEMIS & CARDEN, Chicago.

"Saves twelve hours time in drying."
PH. BEST BREWING CO., Milwaukee.

"Materially improves color and quality."
VALENTINE BLATZ, Milwaukee.

"We cannot but recommend these wheels for ventilation of kilns, as they are *inexpensive and require little power* to run them."
PH. BEST BREWING CO., FRED PABST, President.

Fresh wet malt requires at first a strong current of cool air. This is not possible to obtain except by our system.

Malt dried by slow current is heavy and lumpy. Our system thoroughly separates the grain in drying.

Malt dried by ordinary means requires frequent turning. Our system saves much of this labor.

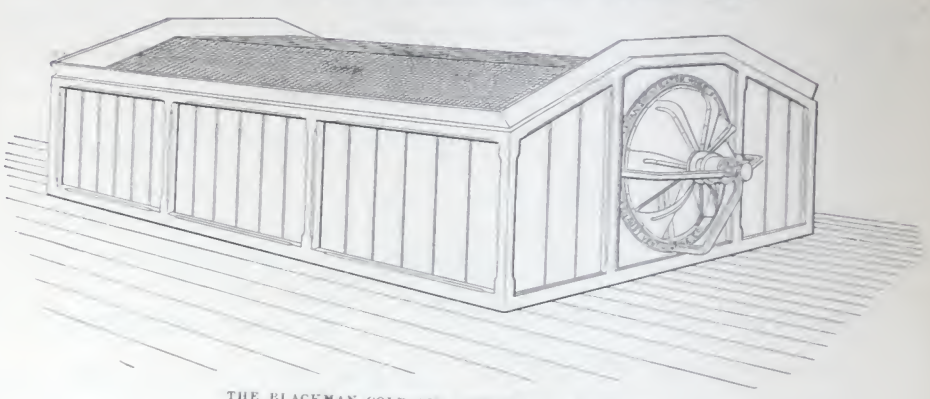
Natural ventilation depends upon heat, and too strong heat darkens the grain. By our system cooler air can be used.

Unfavorable conditions of weather destroy the efficiency of natural ventilation. Our system acts independently of the weather.

This system is secured to us by Letters Patent, granted to:—Altenbrand—April 17, 1877, No. 189,678; Altenbrand—January 23, 1883, No. 271,184. Blackman—December 13, 1881, No. 250,639; Blackman—July 18, 1882, No. 261,128; Blackman, March 13, 1883, No. 273,805; and by them assigned to this Company.

Please read article on drying, page 22.

DRYING WOOL, DYED WOOL, COTTON, HAIR (CURLED OR CURRIED), HEMP, SHODDY, SEEDS, DYED GOODS, ETC.



THE BLACKMAN COLD AIR COTTON AND WOOL DRYER.

For drying of light, bulky material we recommend an arrangement such as has been shown in the above cut. The dryer consists of a long box with the top made of wire netting, upon which the material to be dried is laid. A fan at the end supplies the necessary amount of air, which can be drawn through a steam coil and then forced into the box or chamber passing up through the wire or other material, thus absorbing the moisture. The process may be reversed and the air drawn down through the material if preferred. We furnish dryers as shown above, complete, ready to put together.

With 36 inch fan, table is 9 feet wide by 15 feet long.
" 42 " " 9 " " 20 "
" 48 " " 9 " " 30 "

Prices furnished on application.

From list of users on page 46, the reader can select the firm nearest to him and to that firm we beg leave to refer. The absence of the great heat heretofore necessarily used, greatly improves the quality of the product. The following letters are selected because they cover the field. The success attained in wool and cotton drying holds good throughout this whole class of materials.

THE PHILADELPHIA EXHAUST VENTILATOR CO.

Dear Sirs:—With the 48-inch "Blackman Wheel" you furnished for our combing wool dryer we are highly pleased. It not only has rid us of the unpleasant condition of "no wool dry" that we were annoyed with other disc fans and blowers, but we think we will save its cost in a year by the disuse of steam to heat the drying coils, to say nothing of the benefit we derive from the use of cold air.

The volume of air it gives at the expense of so little power is certainly remarkable, and its result in this direction is far ahead of any apparatus we know of. Our dryer is 30×9 feet, carefully built as near air-tight as possible. Fan at the end blowing in and running 452 revolutions per minute. We are drying every day 2,600 pounds unwashed combing, common to ⅜, which we think will equal anything ever done heretofore, and exceed 90 per cent. of dryers running to-day. We think the "Blackman" has a great future before it and positively endorse all you claim for it. Respectfully,

MONTAGUE & WHITE.

PHILADELPHIA, December 1, 1883.

EXHAUST VENTILATOR CO.

Gentlemen:—We have tested the 36-inch Wheel you sent us, and it gives very good results. We have run the Wheel 600 revolutions per minute. Our table is only 8×17 feet. We dried four hundred pounds of black cotton on it in three hours, and we think we can increase the quantity at least 25 per cent. Respectfully,

WM. EMSLEY & BRO.

PHILADELPHIA, April 1, 1884.

THE PHILADELPHIA EXHAUST VENTILATOR CO.

We have placed your 36-inch Ventilator Wheel on a wool dryer 10 feet by 18 feet, and dry our wool entirely by cold air. The results are very satisfactory and we dry 700 pounds of fine Australian wool in ten hours. We formerly used a No. 4 Sturtevant Blower and hot air, but were not able to dry as much wool even though the dryer frame was much larger. We were often obliged to run the machine at night to get the required amount of stock. Yours truly,

E. P. & H. N. ALMY.

See proposition page 36.
Volume of air moved, page 38.

DRYING OF GOODS HUNG UP IN SHEETS.

CARDBOARD.	OIL CLOTH.	TOBACCO.
CORDAGE.	RUBBER.	BLANKETS.
COCOA MATTING.	SHEEPSKIN.	CLOTH.
FELT.	SKINS.	TEXTILE FABRICS.
HIDES.	WALL PAPER.	DYED GOODS.
KID.	WINDOW SHADES.	RUBBER GOODS.
LEATHER.	BLEACHED GOODS.	PAINTED WARE
MOROCCO.		

Please read article on drying, page 22.

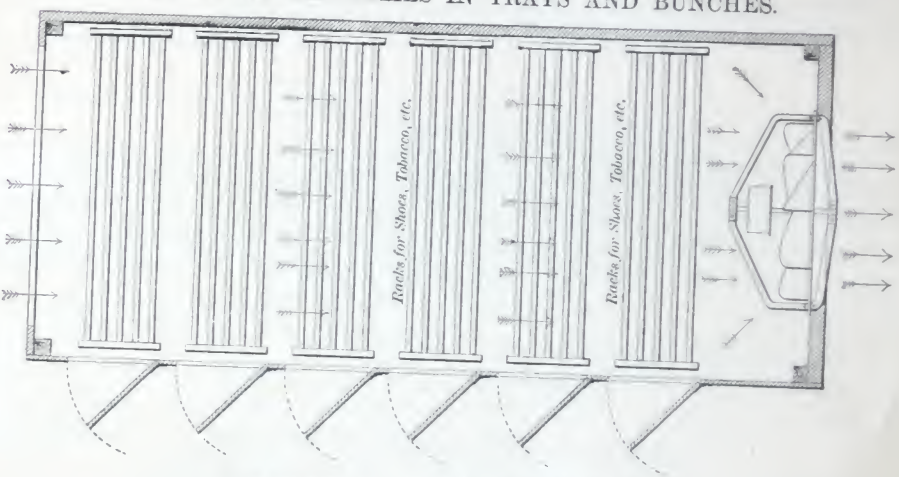
Material hung up in sheets forms another class or department. Ordinarily the material is hung up, and the only means of carrying off the air is by the circulation caused by heat. In one particular instance where the above was the case, our fans were placed in one end of the room and the air admitted at the other, thus being obliged to sweep the entire length of the room, and the gain in time of drying was some 53 per cent. It is not unusual for us to reduce the time of drying one-half—sometimes more. Air in motion, having a choice, of course will always take that offering the

least resistance. By constructing a drying chamber expressly for the particular material, we can often produce a saving of from 60 to 75 per cent. Particular care should be taken when hanging the material, to have no open space through which the air can pass without coming in contact with the substance; the sheets should occupy the entire cross section of the room. In list of users the reader will find many names of those who have found a money-saving gain in the use of our Fans in proper chambers.

Please notice our proposition on page 36.

Volume of air moved, page 38.

DRYING OF MATERIALS IN TRAYS AND BUNCHES.



PLAN SHOWING ARRANGEMENT OF RACKS AND FAN.

APPLES	HATS.	STARCH.
BOOTS AND SHOES.	PAILS.	TOYS.
DYED YARN.	PAINTED GOODS.	TOBACCO.
FRUITS.	PEACHES.	YARN.
GLUE.	RAISINS.	YEAST.
	RAGS.	ETC., ETC.

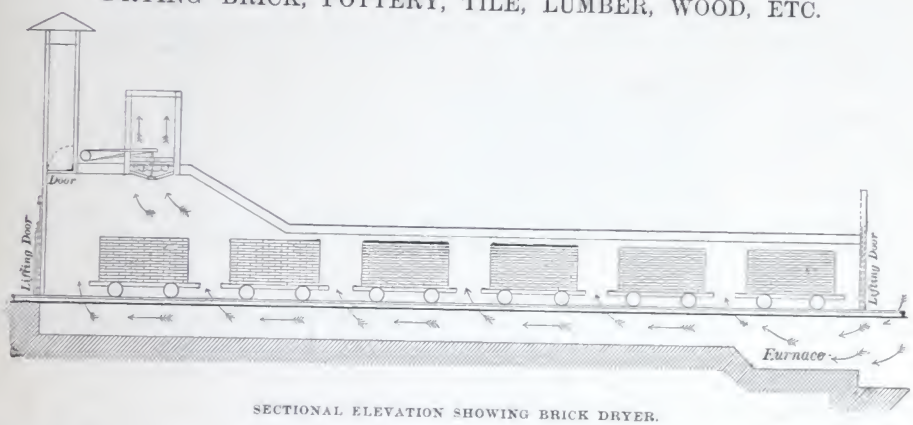
Please see article on drying, page 22.

In drying articles of this class, they are generally put into specially adapted drying-rooms on trays or hung in bunches. The above cut shows a plan of dryer which consists of a box of suitable size into which can be pushed racks of trays piled on a movable truck. A fan is placed at one end, and if necessary some heating arrangement at the other. Generally little or no heat is used, but a rapid current of air is kept up through the dryer, care being taken that the air passes in contact with the material, and not above it or along the sides.

When the goods are supported on trays, the bottom should be made of netting, so that the air can come in thorough contact with the bottom as well as with the top and sides, thus preventing uneven drying. When the material is hung up in bunches, and no injury results from contact of one bunch with another, the most rapid method of drying is to use a large volume fan and draw a rapid current of air through the material with or without heating it.

Please see our proposition on page 36.
Volume of air moved, page 38.

DRYING BRICK, POTTERY, TILE, LUMBER, WOOD, ETC.



SECTIONAL ELEVATION SHOWING BRICK DRYER.

If the reader will examine articles on general principles of drying, on page 22, and this letter from Purington-Kimbell Brick Company, we think this class or department of drying will be fully canvassed.

We will plan, construct and equip a dryer of the above form for your works, and ask your attention to our proposition, page 36.

L. G. FISHER, JR., PRESIDENT EXHAUST VENTILATOR CO., CHICAGO :

Dear Sir :—I have at last reached a point in my experiments with the "Blackman Fan," where I feel justified in calling a halt. Having signally failed in my efforts to induce you to visit our works in person, I now propose to be revenged by compelling you to read a letter history of my experience in Drying Brick, culminating in what I claim to be a success.

Two years ago we commenced the erection of the Chambers Dry Kiln in this city. A few attempts to use a drying floor had been made prior to that time, but had been abandoned, and our Chicago Brick Manufacturers were apparently satisfied if they were able to run 120 days in the year, and were willing their capital and machinery should lie idle the rest of the time.

The dry kiln erected by us was intended to dry the product of a Chambers Brick Machine, which had been guaranteed at 30,000 bricks per day. Under favorable circum-

stances the Dryer filled the bill, but we experienced much difficulty in overcoming obstacles, such as the oftentimes necessarily low temperature of the bricks when they entered the dryer, adverse winds, accumulation of steam in the flues, which softened the bricks so that they became too soft to retain their shape, etc. In pursuing our investigation, our attention was called to the Caldwell Dryer, and we invited Mr. Caldwell to visit our works and make suggestions if he thought best.

He did so, and as result, changes were made embodying also many suggestions of our Superintendent, Mr. Argood, who had used a Caldwell Dryer for six years, thereby giving us a sort of a combination Dryer, with the better features of both the Chambers and Caldwell. With this Dryer we managed to dry our brick, although in an unsatisfactory manner. In the summer of 1882 our attention was called to an invention for a Dry Kiln, by Mr. Burdett Loomis, of Hartford, Conn.

In this Dryer the system adopted involved a furnace for generating hot air, entirely separated from and independent of the drying-room. From this furnace the hot air was drawn by a fan or blower, and forced into the drying-room. Theoretically this is the best system yet used by us, but practically there were so many objections that we have ceased to use it. The furnace was faulty, and the objections existing in the Chambers or Caldwell system were very much augmented in this. The brick receiving the blast of heated air would dry splendidly, but 30 feet away would hardly become warmed through in 24 hours. Indeed we lost a large number of brick by freezing in the dryer. Again, the accumulation of steam formed at that portion of the kiln nearest the hot air ducts would, as soon as it came in contact with the cold air in the other portions of the dryer, condense and spoil the brick. We tried various methods of increasing the circulation of air, but with little success.

Just at this point we met your agent, who, after looking over the ground, expressed the belief that a Blackman Fan would do all that we wanted. At all events he was so sanguine that he offered to put one up on trial, and at his own expense.

Before night of the day this arrangement was entered into, the imperfections of our Loomis Furnace had resulted in the destruction by fire of our dryer.

"Here endeth the second lesson."

This was in March last; since that time we have done the best we could with our first dryer up to about two months ago, when we again had an attack of the fan fever.

It would take too long to write out in full the details of our various experiments.

To ascertain the best location of the fan, its position, size, speed, the amount of heat absolutely necessary to do the work economically, has taken time; yet no matter where they were placed, or how they were run, we have always achieved a better result than before they were put in.

We have now ten 30-inch Fans, each placed horizontally about seven feet from the back (farthest from the furnace) end of our dryer flues, and running about 800 revolutions per minute.

In each one of these flues we can thoroughly dry 5,000 brick in twenty-four hours, without checking, or 50,000 in all Our brick weigh six and one-quarter pounds when they go in and five when they come out. We are doing this now with the same amount of fuel formerly used to imperfectly dry 30,000 brick. It seems almost incredible to say that we remove 31¼ tons of water with these fans every 24 hours, but if you doubt it spend 24 hours in our yard and see for yourself.

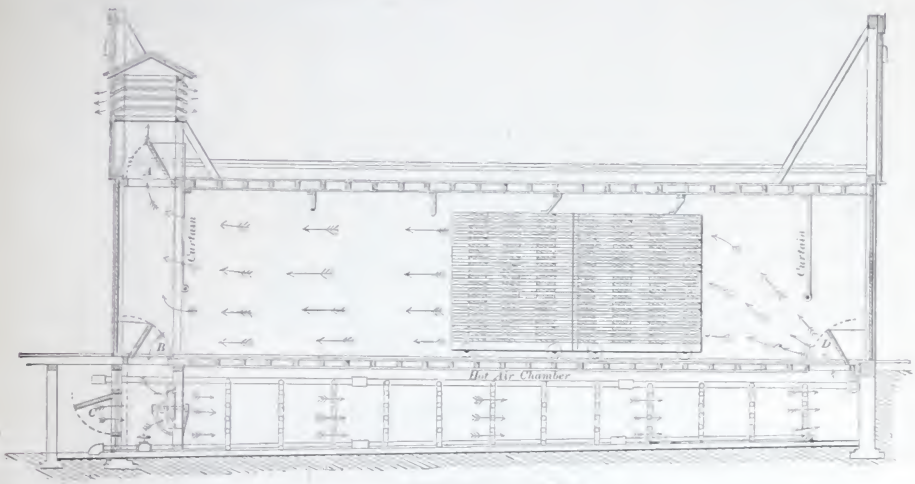
The results are so far beyond our expectations that I think your Company as well as ours may be pardoned for congratulating themselves on the patience and perseverance that have followed these experiments to so satisfactory a conclusion.

This is not due so much to your or my individual efforts, as to those of our employes, who have worked intelligently, faithfully and harmoniously.

I will now say what I intended to say in a few words when I first began, viz.: The ten 30-inch Fans suit ; send us the bill. Yours very truly,

D. V. PURINGTON,
President Purington & Kimbell Brick Co.

See proposition on page 36.



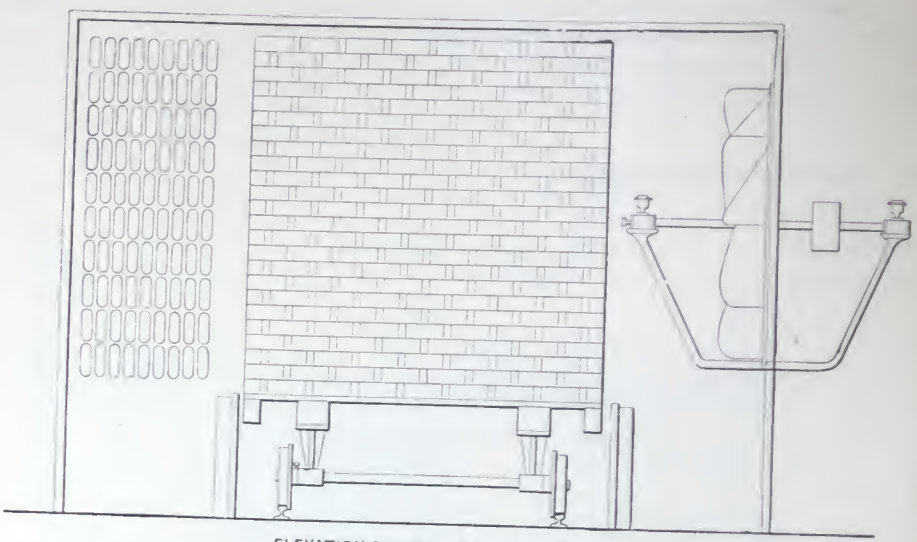
SECTIONAL ELEVATION

The above cut shows a method of drying lumber by maintaining a circulation of air through the room. The fan draws air from outside, forces it through the hot air chamber, where it is heated by the steam coils, and through the lumber in the drying room above. By arranging the dampers provided for the purpose, part of the air can be forced over the same course, being mixed with outside air at a lower temperature.

The illustration on succeeding page shows a rapid dryer for soap and materials of a similar nature. A small amount of heating surface may be used, but a rapid current is produced by using a large-sized fan in the end of the box.

ROTARY DRYER.

Many substances crack, shrink and become distorted when dried on only one side at a time. For the drying of such material, we have devised a rotary table upon which a truck loaded with the material is run. The whole is enclosed and so arranged that different sides are consecutively presented to the current of air, thus preventing uneven drying.



ELEVATION SHOWING SOAP ON CAR

COOLING OF MANUFACTURED ARTICLES.

Many manufactured articles require to be cooled quickly, and in many cases we can accomplish this object at considerable less cost than under the old plans. As an example, we would refer to James Duncan's Sugar Refinery, Victoria Docks, London. Here small vats of crystallized sugar are placed on a truck and run into a chamber which is kept cool by means of a fan, the time of cooling being reduced more than fifty per cent.

Please see proposition on page 36.

Volume of air moved, page 38.

REMOVAL OF STEAM, ETC., FROM PAPER MILLS.

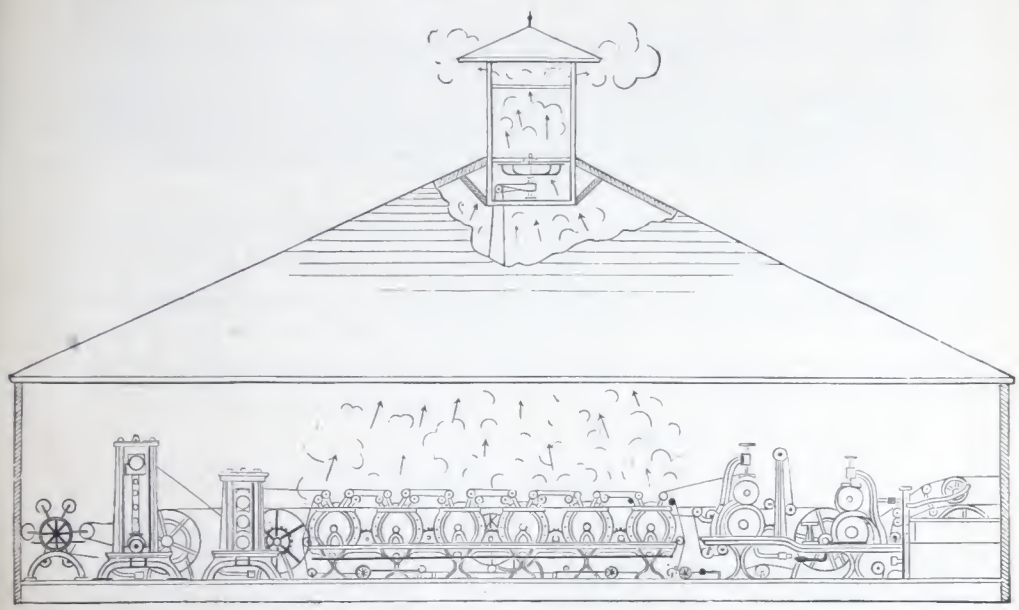
One of the instances of the successful application of the BLACKMAN EXHAUST WHEEL, is the mills of the Lockport Paper Co., Lockport, Ill.

Language cannot convey to one ignorant of the condition of all unventilated paper mills, the volume of steam, dust and chemical gases which fill to overflowing every room. The effect of such a vapor bath is highly injurious to workmen and goods. Every mill-owner appreciates this, and is anxious to improve the ventilation of his mill.

In the Lockport mill, six wheels were placed so as to draw directly from the dryers, as indicated in illustration on following page, and from

the engine vats, rotary bleachers, etc. The result of their use was an entire change in the atmosphere. The steam was instantly removed, no odor of chemicals or of gas could be detected, the walls and floor were dry for the first time, and the paper in better condition. This was accomplished without causing strong or unpleasant draughts.

See list of Removal of Steam, page 53.
Please see our proposition, page 36.
Volume of air moved, page 38.



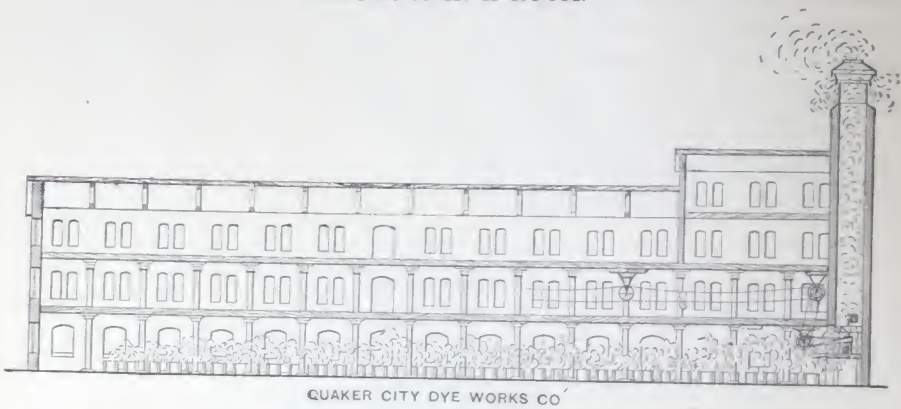
LOCKPORT PAPER MILLS, LOCKPORT, ILLINOIS.

REMOVAL OF STEAM, ETC., FROM BOILERS, VATS, ETC.

If a vat generates 1,000 cubic feet of steam per minute, and this vat is in a room $50 \times 30 \times 15$ feet, containing 22,500 cubic feet, there are two ways of removal—one is to move all the air in the room, causing a great change in the temperature, and requiring larger horse-power and wheel ; the other way is to pipe direct to origin and capture the steam as fast as generated. In one instance, the work done is to take off 1,000 cubic feet, in the other, 22,500 feet must be moved. We therefore recommend piping to origin.

Please see proposition on page 36.
Volume of air moved, page 38.

REMOVAL OF STEAM, DUST, GAS, ETC., WHICH RISES FROM MANY SOURCES IN A ROOM.



QUAKER CITY DYE WORKS CO

When the origins are so numerous as to make it necessary to clear the whole room to maintain a pure atmosphere, we place fans in the windows or ceiling and arrange the inlet openings so that the circulation extends through the whole room. Where possible, we prefer to arrange hoods and piping so as to catch and carry away the steam, etc., before it has an opportunity to spread.

See proposition on page 36.

PACKING HOUSES.

The success of the BLACKMAN WHEEL as an exhaust fan strongly commends it to the favorable attention of the owners of packing houses for the efficient removal of heat, steam and stench, without seriously affecting the temperature, while improving the quality of the meat.

LAUNDRIES.

Messrs. H. M. Munger & Co., of Chicago, the well-known laundrymen, have seven of Blackman's Ventilators in use in their various laundries. In answer to a question as to the value of this Ventilator to laundries, Mr. Munger says: "Why, it is simply indispensable. In my opinion it is the most important thing for laundries that has yet been introduced. It removes all the steam and smoke and creates a cooling breeze in the hottest of weather. Previous to the introduction of these wheels into my laundries, it was a very frequent occurrence for my operatives to become prostrated by the heat, but now we experience no such trouble."

Please see proposition on page 36.

TUMBLERS.

Under ordinary circumstances, the dust from the tumblers used in foundries for cleaning castings fills the air with a suffocating powder. This, with much of the heavier dust, we are able to effectually remove by a strong exhaust through pipes carried directly to the point where the dust originates.

See proposition, page 36.
Volume of air moved, page 38.

BUFFING AND EMERY WHEELS.

In the polishing rooms of the Adams & Westlake Manufacturing Co., we have put two fans and a system of piping to carry off the dust from the emery and buffing wheels. The openings in the pipes are easily adjusted so as to draw in all the dust, etc., before it has an opportunity to escape into the room. With this apparatus, the room and machines are kept clean, and by a specially contrived cage, the material carried away is prevented from escaping into the air and working its way back into the factory.

See proposition, page 36.
Volume of air moved, page 38.

REMOVAL OF HEAT FROM STEREOTYPING, NEWSPAPER AND PRINTING ROOMS.

The following extract, from an article published soon after the introduction of the wheel into the *Tribune* building, will explain itself.

A New System that Revolutionizes all others in Point of Thorough and Complete Displacement of Hot and Foul Air.

(*From the Chicago Tribune, Sept. 10, 1882.*)

It is but proper, before closing this short sketch of a valuable invention, to refer to the experience of the *Tribune* Company.

The stereotyping room of a newspaper is, of all earthly places, the hottest and most uncomfortable. Since Hell has been expurged (see Revised Edition), it should take its place as the synonym of aggravated diabolical intense heat.

Various methods had been tried to render that of the *Tribune* habitable, but without avail, and we were, at the time the Exhaust Ventilator Company presented their device, removing an elaborate and costly wheel that had been on trial and accomplished nothing. The manufacturer of this new invention solicited a trial, guaranteeing success. Consent was given, and a wheel placed in proper position and run. The effect was instantaneous and magical. A current of hot air shot out of the window, and a stream of cool, fresh air was drawn into the room, which in its turn was sucked into the fast revolving wheel and thrown out.

A draught was created that was strong enough near the doorways to take off one's hat. Not only was this one large room thoroughly and most effectually cooled and ventilated, but even the air in the counting-office up-stairs, and in the intermediate rooms, was drawn toward the wheel, and a current created that had a wonderful effect on the temperature there. This simple and inexpensive wheel accomplished all that had been striven for, and seemed to have resources within itself for greater efforts. The *Tribune* has no hesitation in recommending it above all other devices for the purposes for which it is intended.

See testimonials, page 48.

CHILL ROOMS, REFRIGERATORS, COLD STORAGE WAREHOUSES, ETC.

By the application of a proper system of air movement to this class of work, we can accomplish better results in maintaining a low temperature than was obtained by the old system of ice refrigerating—we can circulate air through the material, and then return it to be again cooled, thus preventing loss which would be occasioned if we drew in new air.

Please see our proposition below.

Volume of air moved, page 38.

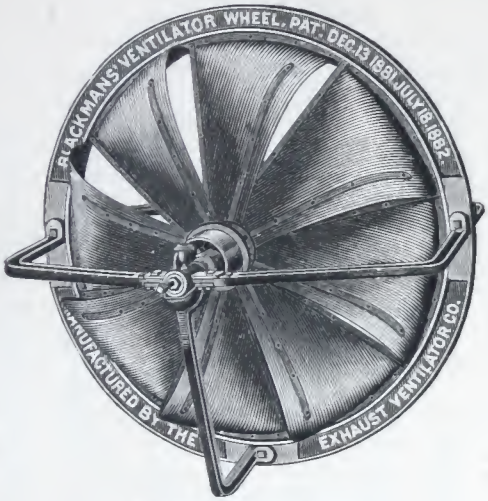
SPECIAL DEVICES.

In many cases which do not come under the foregoing general classes, special devices must be contrived in order to produce the results aimed at. Particularly where the above is the case, we refer the reader to the following proposition.

PROPOSITION.

In regard to or about any form of Drying, Heating, Cooling or Removal of Air, this Company will gladly give advice when the facts are known. If the matter is submitted to us in the form of sketch, drawing, or plans, we will return our drawings and plans made after full examination by our experts, together with estimates as to the cost of the work suggested by us; details as to piping, size of fan, horse-power, volume removed, results, etc., etc. While this offer is in the effort to increase our business and extend the field of the fan's usefulness, it is made gratuitously and without any obligation on behalf of the inquirer.

THE BLACKMAN EXHAUST WHEEL AND AIR PROPELLOR.



FRONT VIEW OF WHEEL.

Size of Fan	Diameter of Pulley.	Area of Circle, Same Diameter.	Feed Area. Due to Peripheral flange.
12 inch	3 inches	0.79 square feet	1.30 square feet
18 "	3½ "	1.77 "	2.95 "
24 "	4½ "	3.14 "	5.23 "
30 "	6 "	4.91 "	8.18 "
36 "	7 "	7.07 "	11.78 "
42 "	8 "	9.62 "	16.04 "
48 "	9 "	12.57 "	20.95 "
5 feet	12 "	19.64 "	32.73 "
6 "	16 "	28.27 "	47.12 "
7 "	18 "	38.48 "	64.13 "
8 "	20 "	50.27 "	83.78 "
9 "	24 "	63.62 "	106.03 "
10 "	28 "	78.54 "	130.90 "

TABLE SHOWING CUBIC FEET OF AIR MOVED BY BLACKMAN AIR PROPELLOR.

Number of Revolutions of Wheel per Minute.	Amount of Air Thrown in Cubic Feet Per Minute.								
	18 Inch.	Inch.	30 Inch.	36 Inch.	42 Inch.	48 Inch.	54 Inch.	60 Inch.	72 Inch.
100	....	....	....	....	....	4,245	6,059	8,387	14,936
110	....	....	....	....	....	4,676	6,665	9,258	16,506
120	....	....	....	....	....	5,100	7,278	10,137	18,090
130	....	....	....	....	....	5,530	7,897	11,024	19,688
140	....	....	....	....	....	5,965	8,522	11,919	21,300
150	....	....	....	....	....	6,405	9,154	12,822	22,926
160	....	....	....	....	....	6,851	9,792	13,733	24,566
170	....	....	....	....	....	7,302	10,437	14,652	26,220
180	....	....	....	....	5,038	7,758	11,008	15,579	27,880
190	....	....	....	....	5,321	8,219	11,746	16,514	29,570
200	....	....	....	3,594	5,607	8,686	12,410	17,457	31,266
210	....	....	....	3,779	5,896	9,158	13,088	18,408	32,976
220	....	....	2,341	3,966	6,188	9,635	13,764	19,367	34,700
230	....	....	2,457	4,155	6,482	10,117	14,447	20,334	36,438
240	....	....	2,575	4,347	6,779	10,605	15,136	21,309	38,190
250	....	1,587	2,696	4,541	7,079	11,098	15,832	22,292	39,956
260	....	1,444	2,819	4,738	7,382	11,596	16,534	23,283	41,736
270	....	1,502	2,945	4,937	7,688	12,099	17,243	24,282	43,530
280	....	1,561	3,074	5,139	7,996	12,609	17,958	25,289	45,338
290	....	1,622	3,205	5,343	8,307	13,122	18,680	26,304	47,160
300	894	1,684	3,338	5,550	8,621	13,641	19,408	27,327	48,996
310	927	1,747	3,474	5,759	8,938	14,165	20,143	28,358	50,846
320	961	1,812	3,612	5,971	9,258	14,695	20,884	29,397	52,710
330	995	1,878	3,753	6,185	9,580	15,230	21,632	30,444	54,588
340	1,019	1,945	3,896	6,402	9,905	15,770	22,386	31,499	56,480
350	1,047	2,014	4,042	6,621	10,233	16,315	23,147	32,562	58,386
360	1,083	2,083	4,190	6,843	10,564	16,865	23,914	30,633	60,306
370	1,111	2,154	4,344	7,067	10,898	17,421	24,688	34,712	62,240
380	1,132	2,227	4,494	7,294	11,234	17,982	25,468	35,799	64,188
390	1,174	2,300	4,650	7,523	11,573	18,508	26,255	36,894	66,103
400	1,202	2,375	4,808	7,755	11,915	19,119	27,048	37,997	67,985
410	1,233	2,452	4,969	7,989	12,260	19,696	27,748	39,108	69,834
420	1,258	2,529	5,132	8,221	12,608	20,278	28,654	40,227	71,650
430	1,287	2,608	5,298	8,464	12,958	20,865	29,467	41,354	73,433
440	1,325	2,688	5,466	8,706	13,311	21,457	30,286	42,489	75,183
450	1,347	2,770	5,636	8,950	13,667	22,055	31,112	43,632	76,900
460	1,372	2,853	5,808	9,197	14,026	22,658	31,944	44,783	78,584
470	1,402	2,937	5,982	9,446	14,388	23,268	32,783	45,942	80,235
480	1,441	3,022	6,158	9,698	14,752	23,884	33,628	47,109	81,853
490	1,468	3,109	6,336	9,953	15,119	24,503	34,480	48,284	.....
500	1,499	3,197	6,516	10,210	15,489	25,127	35,338	49,467	.....
510	1,533	3,286	6,698	10,470	15,862	25,755	36,203	50,640	.....
520	1,558	3,376	6,882	10,632	16,238	26,390	37,074	51,795	.....
530	1,591	3,468	7,068	10,997	16,616	27,030	37,952	52,932	.....
540	1,618	3,561	7,256	11,162	16,997	27,675	38,836	54,051	.....
550	1,651	3,656	7,446	11,430	17,381	28,325	39,727	55,152	.....
570	1,679	3,752	7,638	11,702	17,768	28,980	40,624	56,235	.....
580	1,707	3,849	7,832	11,977	18,158	29,640	41,528	57,300	.....
590	1,742	3,947	8,028	12,254	18,550	30,303	42,438	58,347	.....
600	1,767	4,047	8,226	12,534	18,945	30,909	43,355	59,376	.....
610	1,799	4,148	8,426	12,816	19,345	31,518	44,277	60,401	.....
620	1,832	4,250	8,628	13,101	19,744	32,110	45,208	.....	.....
630	1,863	4,354	8,832	13,388	20,148	32,685	46,144	.....	.....
640	1,887	4,459	9,038	13,678	20,554	33,243	47,087	.....	.....
650	1,923	4,565	9,246	13,970	20,963	33,784	48,036	.....	.....
660	1,953	4,671	9,456	14,265	24,375	34,310	48,992	.....	.....
670	1,981	4,779	9,668	14,562	21,790	34,836	49,954	.....	.....
680	2,011	4,888	9,882	14,862	22,202	35,362	50,923	.....	.....
690	2,038	4,998	10,098	15,164	22,611	35,888	51,898	.....	.....
700	2,066	5,109	10,316	15,469	23,017	36,414	52,880	.....	.....
	2,098	5,221	10,536	15,776	23,420	36,940	53,858	.....	.....

GENERAL INFORMATION ABOUT LOCATION OF FANS WITH INSTRUCTIONS FOR SETTING.

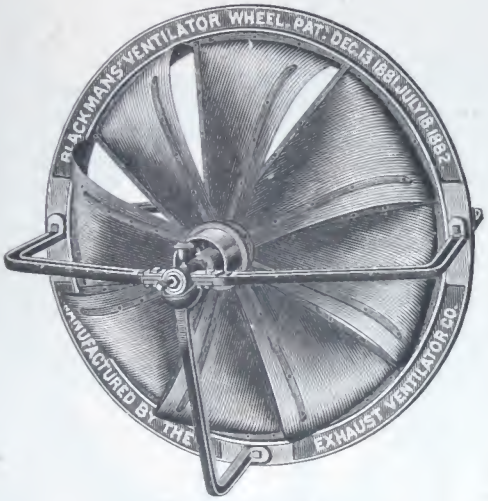


Illustration I.

The above cut shows The Blackman Exhaust Fan and Air Propellor, from 12 to 48 inches diameter inclusive, ready for shipment. The larger sizes from 5 feet diameter up are made without the arms and frame, as they are generally placed in positions where frames would be unnecessary.

Illustration I shows a right handed fan, the top of which turns from left to right, and draws the air in from the side toward the reader.

The fan as shown above, is ready for application of power upon being fastened to wall or partition.

Left handed fans, longer or shorter shafts, special pulleys, etc., furnished on special order.

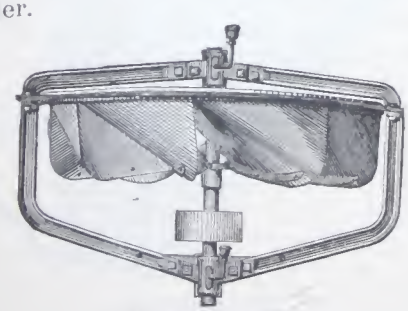


Illustration II.

When a fan is to run horizontally, we furnish it complete as shown in illustration II.

In placing fans in position, we advise the erection of a strong frame secured to the opening in wall or partition with lag screws or bolts with screw nuts.

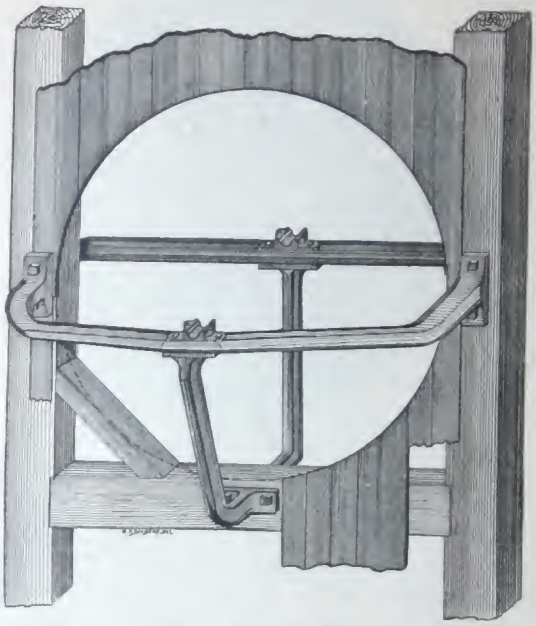


Illustration III.

The entire surface of framework should be covered with planking, and a circle cut out the exact diameter of the flange on inside edge of cast iron frame. This frame should be secured to the wood-work by carriage bolts running through to opposite side, care being taken that the frame is perfectly vertical so that the bolt will run true on the pulley.

Illustration III shows cast-iron arms as made for a five-foot fan bolted to the wooden frame.

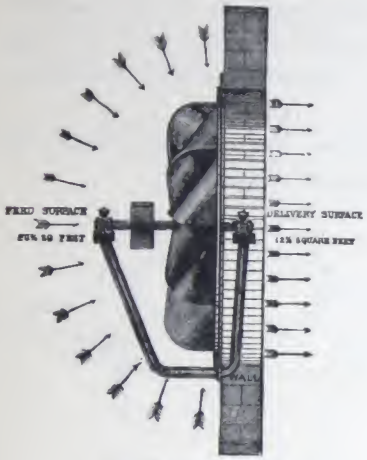


Illustration IV.

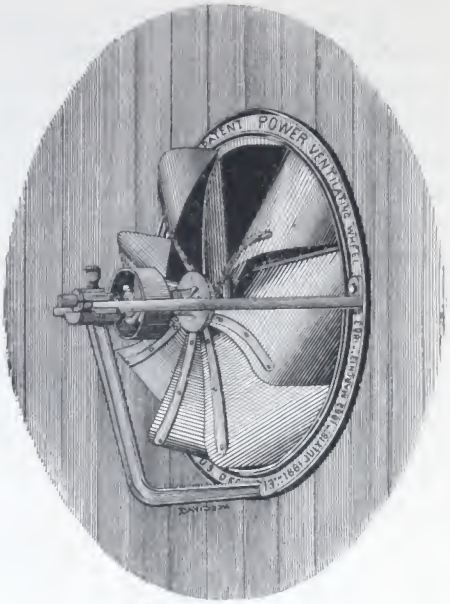


Illustration V.

Illustration IV shows a fan fastened directly by lag screws to a brick wall. The top of the opening should be as far as possible from the ceiling so as not to cut off the peripheral feed, but to allow the air free access to the entire rim of the fan.

Illustration V shows the fan in place ready for connection to the driving shaft.

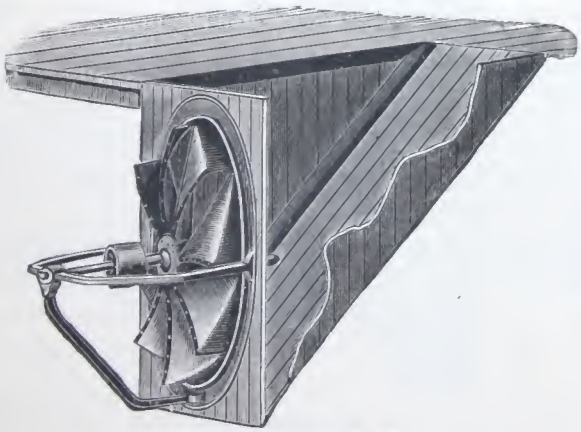


Illustration VI.

When a fan is placed in a basement where the ceiling is flush with the sidewalk as shown in Illustration VI, in order to offer the least resistance, a chute should be built to throw the air upwards instead of directly against the area wall. When a fan is placed horizontally in the roof or ceiling, some arrangement must be devised which will prevent the rain beating in, and at the same time allow free exit for the air.

The shape and arrangement of the cap placed above the fan, is of the utmost importance, as is shown in the following illustration.

Illustration VII.

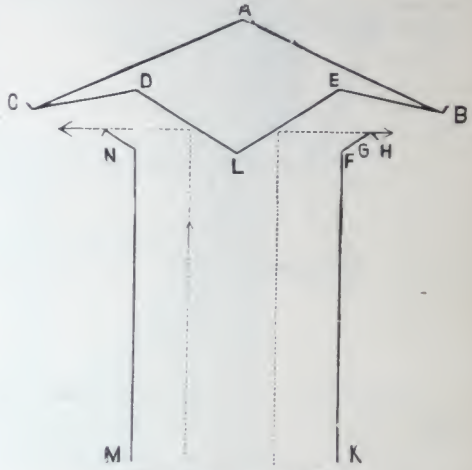


Illustration VIII.

Illustration VII gives an outline of the usual shape of cap and its effect upon the air current. Illustration VIII gives outline of a modification of the cap, so made as to combine efficiency with economy. The air currents shown by dotted lines are deflected by the split D L E. The distance from point G to line E B should equal one-third the width or diameter of shaft at M K. The top A B should project one foot beyond H, while the slant of top may be very slight. The point L is on level with N F, and the line L E should be parallel to F G. To prevent entrance of drip, the flange H projects from G at right angles.

The following illustration shows a patented improvement on the cap shown in Illustration VIII. The portion which is made with the cone-shaped split is movable so as to be easily raised and lowered along the centre guide rod. By this arrangement, the opening for escape of air may be altered at will, and when the fan is not running, the opening may be closed water and air-tight by simply pulling the "damper" down. It is so balanced that only a slight pull is necessary.

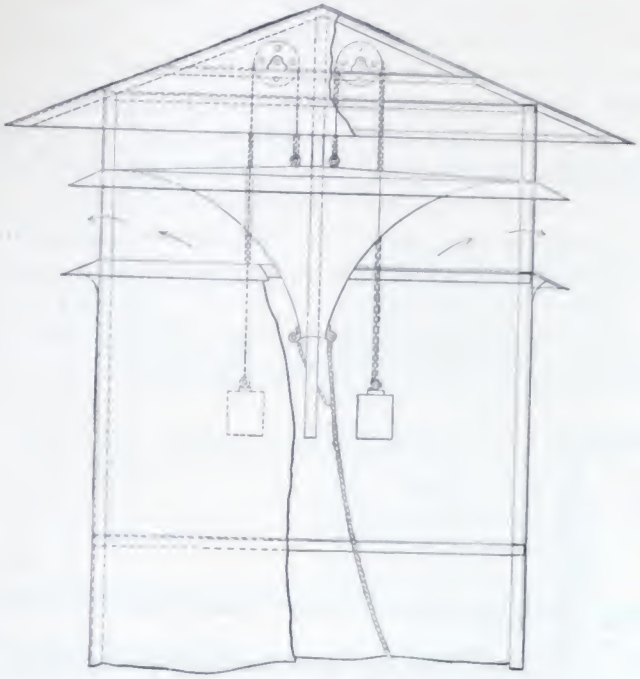


Illustration IX.

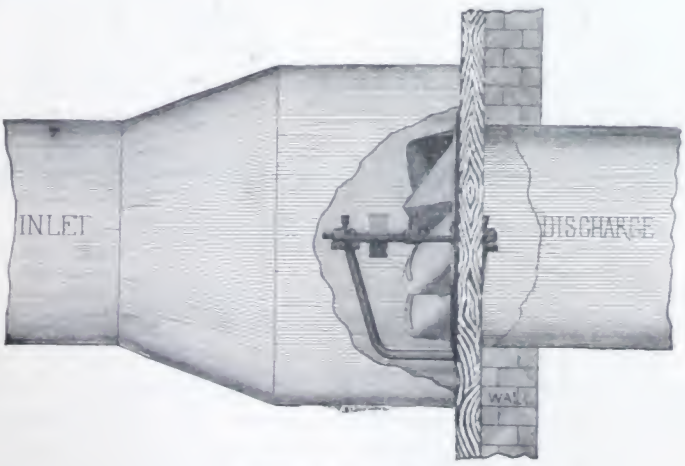


Illustration X.

When the fan is enclosed in a pipe or exhaust chamber, the general arrangement should be as shown in Illustration X. The inlet pipe should be enlarged one-fourth of the diameter of the wheel for a distance back equal to about the diameter of the wheel where it is made tapering to the size of the main pipe. This latter should be equal to or larger than the diameter of the fan. The discharge pipe should be *at least* as large as the fan.

If the fan is placed horizontally as shown in Illustration II, and a pipe carried to it, the same rules should be observed with the addition that the discharge should be entirely open or else covered with a properly designed cap.

Sometimes it is desirable to use one fan to ventilate two distinct rooms without drawing the air from one through the other.

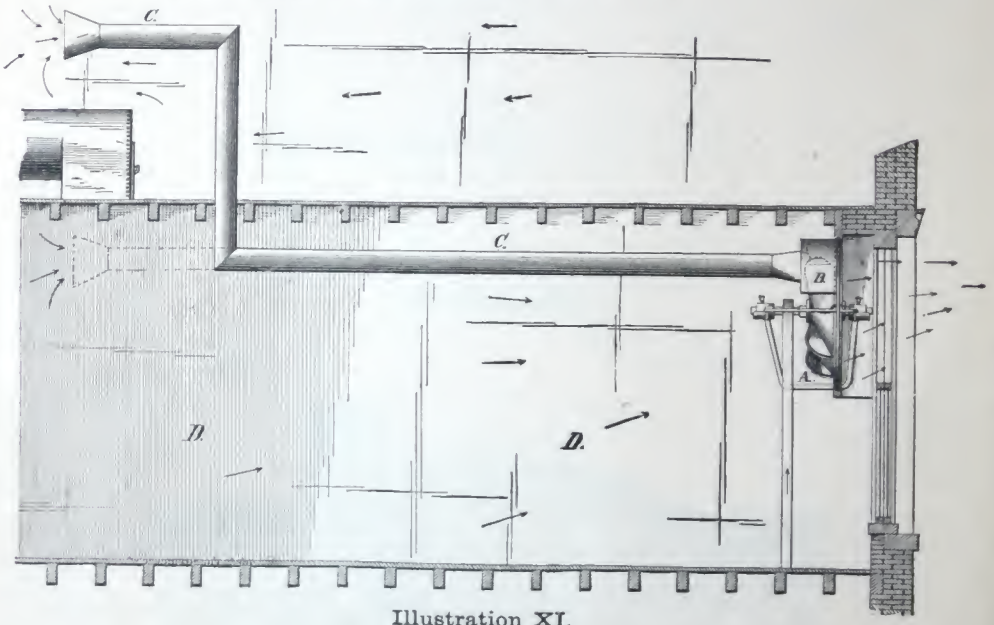


Illustration XI.

For instance, Illustration XI, fan A is used to ventilate the room D, and also to draw the heat and dust from over the boiler at C. In order to accomplish this, the upper part of the fan is covered by a hood B from which is carried the pipe C leading to the boiler room, or to the remote position of D as shown by the dotted lines. By this arrangement, the heated air of the boiler room is drawn out without mingling with the air in D.

The elbows in the pipe leading to C should not be made right-angled as shown, but should be curves of as long radius as possible.

THE BLACKMAN EXHAUST FANS AND AIR PROPELLORS

Are now in use by the following parties (using from one to ten wheels each), and we would respectfully refer to them as to the merits and efficiency of the wheels in practical use.

Removing Steam, Heat, or Dust from Paper Mills.

Warner, Newman & Warner, Minneapolis, Minn.
Lockport Paper Co., Lockport, Ill.
Cedar Falls Paper Co., Cedar Falls, Ia.
Atlas Paper Co., Appleton, Wis.
George H. Friend & Son, West Carrollton, O.
Winnebago Paper Co., Neenah, Wis.
Averill, Russell & Carpenter, St. Paul, Minn.
Cleveland Paper Co., Cleveland, O.
Mead Paper Co., Dayton, O.
Patten Paper Co., Appleton, Wis.
Appleton Paper & Pulp Co., Appleton, Wis.
Becket, Laurie & Co., Hamilton, O.
L. Snider's Sons, Hamilton, O.
Tytus Paper Co., Middletown, O.
N. W. Taylor Paper Mills, South Bend, Ind.
Kalamazoo Paper Co., Kalamazoo, Mich.
Valley Paper Co., Appleton, Wis.
J. F. Clark, Marseilles, Ill.
Van Nortwick Paper Co., Batavia, Ill.
Fox River Flour & Paper Mills, Appleton, Wis.
Kimberly & Clark, Neenah, Wis.
John Lang, Philadelphia, Pa.
M. & W. H. Nixon, Philadelphia, Pa.
Bushong Paper Co., Reading, Pa.
Minneapolis Strawboard Co., Minneapolis, Minn.
Elmwood Paper Mill, Elmwood, Ill.
Portage Strawboard Co., New Portage, O.
Tileston & Hollingsworth, Mattapan, Mass.
H. F. Watson, Erie, Pa.
Hugh McInness, Norristown, Pa.
A. M. Collins Son & Co., Cardboard, Philadelphia.
J. B. Broomall, Cardboard, Ercildown, Pa.
C. R. Remington & Son, Watertown, N. Y.
Hollingsworth & Whitney, South Braintree, Mass.
Fall Mountain Paper Co., Bellows Falls, Vt.
Russell Paper Co., Lawrence, Mass.
Montague Paper Co., Turner's Falls, Mass.
Exeter Wood Pulp Co., Snow's Falls, Me.
Spalding & Hodge, So. Darenth, Kent, Eng.
Jos. Town & Sons, Keighley, York, Eng.
Daily Telegraph Mills, Dartford Creek, Kent, Eng.
J. Dickinson & Co., Nemil Hempstead, Eng.
R. & J. C. Wakefield, Eynsham Paper Mills, Oxfordshire, Eng.
W. & J. Somerville, Britton Paper Mill, Bristol, Eng.
Whitmore Manufacturing Co., Holyoke, Mass.
Herman Harder, Albany, N. Y.
T. New, New York City.
Winnipiseogee Paper Co., Franklin, N. H.
F. R. Walker & Son, East Hartford, Conn.
Warren Manufacturing Co., Warren, N. J.
Geo. West, Balston Spa, N. Y.
Rochester Paper Co., Rochester, N. Y.
L. Waterbury & Co., Brooklyn, E. D. N. Y.
Cumberland Mills, Cumberland Mills, Me.
Allen Bros., Sandy Hill, N. Y.
Wait & Richards, Sandy Hill, N. Y.
Orrs & Co., Troy, N. Y.
J. H. & A. Whiteside, Champlain, N. Y.
Glens Falls Paper Mill Co., Glens Falls, N. Y.
Remington Paper Co., Watertown, N. Y.
Frombach Paper Co., Kaukauna, Wis.
Susquehanna Water Power & P. Co., Conowings, Md.
Richmond Bros., Appleton, Wis.
Canada Paper Co., Windsor Mills, Can.
Dominion Paper Co., Kingsey Mills, Can.
Lachute Paper Mills, Lachute, Can.
Morrison, Bare & Cass, Tyrone, Pa.
Peebles & Son, N. Burnley, Eng.
Jas. Wrigley & Son, Bury, Eng.
J. & W. Dixon, Markinch, N. B.
Baldwin & Son, Birmingham, Eng.
Hollingsworth & Co., Maidstone, Eng.
Taylor Bros., Toronto, Can.
Cumberland & Presumpscot Mill, Cumberland, Me.
Hudson River Water Power & Paper Co., Mechanicsville, N. Y.
Stewart & Carmichael, Amsterdam, N. Y.
Ticonderoga Pulp & Paper Co., Ticonderoga, N. Y.
Lake George Pulp & Paper Co., Ticonderoga, N. Y.
Niagara Wood Paper Co., Niagara Falls, N. Y.
Hart Lot Paper Co., Skaneateles, N. Y.
F. G. Weeks, Skaneateles, N. Y.
Skaneateles Paper Co., Skaneateles, N. Y.
Howland & Co., Sandy Hill, N. Y.
Weed Paper Co., Malone, N. Y.
Moore, Ames & Thompson, Bellows Falls, Vt.

Ventilating Paper Bag Factories.

Union Bag & Paper Co., Chicago, Ill.
Smith, Dixon Co., Baltimore, Md.
E. J. Howlett & Son, Philadelphia, Pa.
Samuel Cupples, St. Louis, Mo.
Chatfield & Woods, Cincinnati, O.

Drying Wall Paper.

Janeway & Co., New Brunswick, N. J.
Janeway & Carpenter, New Brunswick, N. J.

Ventilating Cotton and Woolen Mills.

Amazon Hosiery Co., Chicago, Ill.
Appleton Woolen Mills, Appleton, Wis.
Princeton Manufacturing Co., Athens, Ga.
Southern Woolen Manufacturing Co., Louisville, Ky.
J. Farnum & Co., Lancaster, Pa.
Ashworth & Downey, Chester, Pa.
Clark & Hosapple, Cohoes, N. Y.
Le Roy & Lamb, Cohoes, N. Y.
Montague & White, Philadelphia, Pa.
Hillsboro Woolen Mills, Hillsboro, N. H.
Sawyer Woolen Mills, Dover, N. H.
City Mills Co., City Mills, Mass.
James Roy & Co., West Troy, N. Y.
John Irving & Co., New Brighton, S. I.
Peters Manufacturing Co., Newark, N. J.
Arlington Mills, Lawrence, Mass.
French & Ward, Stoughton, Mass.
W. K. Dana & Co., Saccarappa, Me.
Sayles & Nichols, Pascong, R. I.
Lorraine Manufacturing Co., Pawtucket, R. I.
Peacedale Manufacturing Co., Peacedale, R. I.
Providence Worsted Mills, Providence, R. I.
Wanskuck Co., Providence, R. I.
Thomas J. Hill, Hills Grove, R. I.
Steere Mills, Wanskuck, R. I.
Montaup Mills, Fall River, Mass.
Appleton Co., Lowell, Mass.
W. S. Taylor & Bloodgood, Cranford, N. J.

Dunnell Manufacturing Co., Pawtucket, R. I.
North Berwick Co., North Berwick, Me.
Thomas Oakes & Co., Bloomfield, N. J.
B. W. Gleason & Sons, Rock Bottom, Mass.
Clear Lake Woolen Mills, La Porte, Ind.
Dudley Hosiery Mills, Newton Lower Falls, Mass.
Verlinden Bros., Darby, Pa.
Hudon Cotton Mills, Hocheloga, Can.
Benn & Son, Great Horton, Bradbury, Eng.
J. G. Walthew & Mayoh, Stockport, Eng.
Davidson & Hayden, Milwaukee, Wis.
Warren Manufacturing Co., Warren, R. I.
Attawaugan Mill, Killingly, Conn.
Pequot Mill, Montville, Conn.
Elizabeth Mill, Hill's Grove, R. I.
H. H. Pawling, Amsterdam, N. Y.
C. H. & F. H. Stott, Hudson, N. Y.
Star Hosiery Mills, Hageman's Mills, N. Y.
W. E. Hooper, Baltimore, Md.
Clyde Point Works, River Point, R. I.
Richard Harrison, Pawtucket, R. I.
Ludlow Manufacturing Co., Ludlow, Mass.
Oneko Mills Co., New Bedford, Mass.
Shaw, Esrey & Co., Chester, Pa.
Geo. Campbell & Co., Philadelphia, Pa.
Thos. Dolan & Co., Philadelphia, Pa.

Drying Cotton or Wool.

King & Fildes, La Porte, Ind.
Appleton Woolen Mills, Appleton, Wis.
F. Mulhauser & Co., Cleveland, O.
Muscogee Manufacturing Co., Columbus, Ga.
Falls City Jean and Woolen Co., Louisville, Ky.
Eclipse Woolen Mills, Louisville, Ky.
Evansville Cotton Manuf'ing Co., Evansville, Ind.
C. B. & W. M. Robinson, Louisville, Ky.
Buell Manufacturing Co., St. Joseph, Mo.
J. M. Brown & Co., Norristown, Pa.
Cleveland Woolen Co., Cleveland, O.
Wm. Emsley & Bro., Philadelphia, Pa.
Cook, Parkhill & Co., Louisville, Ky.
J. G. Leinbach & Co., Reading, Pa.
E. P. & H. M. Almy, Philadelphia, Pa.
Auburn Woolen Co., Auburn, N. Y.
J. & S. Lees, Conshohocken, Pa.
Folwell, Bros. & Co., Philadelphia, Pa.
Root Manufacturing Co., Cohoes, N. Y.
Montague & White, Philadelphia, Pa.
Beckman, Senior & Co., Cleveland, O.
F. K. Stevens, shoddy, Chicago, Ill.
Wm. Hall & Co., Jamestown, N. Y.
Harvard Mills, Harvard, Mass.
G. W. Hollis & Co., Brighton, Mass.
Lippitt Woolen Co, Woonsocket, R. I.
Arlington Mills, Lawrence, Mass.
Glenside Woolen Mills, Skaneateles Falls, N. Y.
Verlinden Bros., Darby, Pa.
Portage Hosiery Co., Portage, Wis.
H. T. Thompson & Co., Chicago, Ill.
Tullahoma Woolen Mills, Tullahoma, Tenn.
Island Woolen Co., Baraboo, Wis.
Joshua Pierce & Co., Bristol, Pa.
Johnstown Manufacturing Co., Johnstown, Pa.
Jos. Fling & Son, Germantown, Pa.
Rhodes & Bro., Aston Mills, Pa.
Shaw, Esray & Co., Chester, Pa.
The A. Campbell Manufacturing Co., Manayunk, Pa.
Mackinnon & Denby, Paterson, N. J.
Geneva Worsted Mill, Geneva, R. I.
Quaker City Dye Works, Philadelphia, Pa.
John Williams & Son, Philadelphia, Pa.
Erben, Search & Co., Philadelphia, Pa.
Richard Hey, Manayunk, Pa.
J. & J. Shaw & Co., Norristown, Pa.
P. McGraw, Pittsburg, Pa.
Morris & Ott, Manayunk, Pa.
Richard Kershaw, Philadelphia, Pa.
Firth & Foster Bros., Philadelphia, Pa.
Richard Williamson & Co., Philadelphia, Pa.
Sam'l Greenwood & Son, Centreville, Pa.

Ventilating Silk Mills.

Edward Reily, Paterson, N. J.
R. & H. Simon, Union, N. J.
Givanand Bros., New York City.
Poidebard Silk Manufacturing Co., Jersey City, N. J.
Phipps & Train, Lakewood, N. J.
Cheney Bros. Son, Manchester, Conn.

Removing Steam From Dye Houses and Bleacheries.

R. Klauder & Co., Philadelphia, Pa.
Greenwood & Bault, Philadelphia, Pa.
W. F. & F. C. Sayles, Saylesville, R. I.
S. H. Green & Co., Riverpoint, R. I.
H. H. Green & Son, Pawtucket, R. I.
R. Harrison, Pawtucket, R. I.
Barrett, Palmer & Heal, Walton, N. J.
Switz Conde, Oswego, N. Y.
Mosshassuck Bleachery, Saylesville, R. I.
Otto Pietsch, Milwaukee, Wis.
Batterill, Potter & Co., Bradford, Eng.
Ed. Ripley & Son, Bowling, Bradford, Eng.
Theo. Morganstein, Philadelphia, Pa.
Quaker City Dye Works Co., Philadelphia, Pa.
J. Morton Brown, Philadelphia, Pa.
Frith & Foster Bros., Philadelphia, Pa.
Chadwick Bros., Newburgh, N. Y.
Fletcher Manufacturing Co., Providence, R. I.
Silver Springs Bleachery & Dye Wk., Providence, R. I.
Verlinden Bros., Darby, Pa.
John Farnum & Co., Lancaster, Pa.
Ashworth & Downey, Chester, Pa.
R. J. Walker, Philadelphia, Pa.
James G. Knowles, New Castle, Del.
W. E. Hooper & Sons, Baltimore, Md.
Clough & Carson, Philadelphia, Pa.

Removing Steam from Cloth Sponging and Refinishing Works.

L. Schwarzwaelder, Philadelphia, Pa.
Theo. Tiedemann, New York City.
R. J. Walker, Philadelphia, Pa.
Samuel Lea & Son, Philadelphia, Pa.

Removing Steam and Heat from Shirt and Collar Factories.

Earl & Wilson, Troy, N. Y.
Geo. P. Ide, Bruce & Co., Troy, N. Y.
Tim & Co., Troy, N. Y.
James L. Libbey & Co., Glens Falls, N. Y.
Miller & Bingham, Troy, N. Y.
Reade, Parks & Co., Philadelphia, Pa.
A. H. Sims & Co., Montreal, Can.
Shelton Bros., Montreal, Can.
W. B. Davis & Co., Cleveland, O.
Lewis Lauer & Co., Baltimore, Md.
E. Wise & Sons, Baltimore, Md.
R. H. Anderson, Richmond, Va.

Removing Steam and Heat from Laundries.

Eureka Laundry, Cincinnati, O.
Thomas & Adams, St. Paul, Minn.
Troy Laundry, Milwaukee, Wis.
L. W. Heimsath & Co., Cleveland, O.
Wilson Bros., Chicago, Ill.
D. G. Mitchell, Rockford, Ill.
J. A. Bowden, Columbus, O.
Louisville Steam Laundry, Louisville, Ky.
H. M. Munger, Chicago, Ill.
F. Campbell & Co., Memphis, Tenn.
W. H. Garlock, Cleveland, O.
Aberdeen Steam Laundry, Belfast, Ireland.
Franklin Steam Laundry Co., Belfast, Ireland.
The Wiles Laundry Co., Troy, N. Y.
Edward J. Cannon, Toledo, O.
Van Dusen & Co., Troy, N. Y.

J. W. & W. L. Gardner, Troy, N. Y.
Gardner & Vail, New York City.
San Francisco Laundry, San Francisco, Cal.
T. Bradford & Co., Salford and London.
Hookway & Henry, London, E. C.
Toronto Steam Laundry, Toronto, Can.
Reaume & Syers, Indianapolis, Ind.
Milwaukee Insane Asylum, Milwaukee, Wis.
Montreal Steam Laundry Co., Montreal, Can.
The Wissahickon Inn, Philadelphia, Pa.
Churchill & Peterson, New York City.
Standard Laundry, Chicago, Ill.
Reade, Parks & Co., Philadelphia, Pa.

Drying for Wool Pullers and Sheep-Skin Tanners.

J. Stern & Sons, Philadelphia, Pa.
D. B. Martin, Philadelphia, Pa.
Winter & Goetz, Reading, Pa.
W. Pierson, Philadelphia, Pa.
Porter & Welsh, Chicago, Ill.
Firth & Foster Bros., Philadelphia, Pa.
Jacob Schoening, Philadelphia, Pa.
P. McGraw, Pittsburg, Pa.
Morsch & Hartman, Harrisburg, Pa.

Drying Leather and Morocco.

Wm. Becker, Milwaukee, Wis.
Baum, Little & Co., Philadelphia, Pa.
A. Hammer, Philadelphia, Pa.
Trostel & Gallun, Milwaukee, Wis.
Conrad Bros., Milwaukee, Wis.
Louis Schuman, Philadelphia, Pa.
McNeeley & Co., Philadelphia, Pa.
J. Nevil & Sons, Philadelphia, Pa.
Charles Mullen, Wilmington, Del.
F. Schuman, Philadelphia, Pa.
Pfister & Vogel Leather Co., Milwaukee, Wis.
American Oak Leather Co., Cincinnati, O.
H. A. Pevear & Sons, Lynn, Mass.
Webster & Co., Boston, Mass.
Fairweather & Ladew, New York City.
J. F. Schoellkopfs, Buffalo, N. Y.
Wilder & Hale, Chicago, Ill.
R. Suhm Leather Co., Milwaukee, Wis.
Winter & Goetz, Reading, Pa.
Edward A. Nennig, Easton, Pa.
Blume & Rieber, Philadelphia, Pa.
Winslow Bros., Boston, Mass.
J. S. Barnett & Bro., Little Falls, N. J.
Rose, McAlpine & Co., Yonkers, N. Y.
Patzowisky & Co., N. Y. City.
F. J. Blatz & Bro., Elizabeth, N. J.
Haight & Co., Ballston Spa, N. Y.
Charles W. Meyer, Newark, N. J.
G. B. Horton & Co., N. Y. City.
Barnett Bros. & Aufresser, Albany, N. Y.
Thomas E. Proctor, Peabody, Mass.
J. L. Shoemaker & Co., Philadelphia, Pa.
J. P. Mathieu & Co., Philadelphia, Pa.
Langfield, Davidge & Co., English Centre, Pa.
G. W. Hardenberg, English Centre, Pa.
Schultz, Inness & Co., Jenningsville, Pa.
G. W. Childs, Jenningsvile, Pa.
A. & J. Groetzinger, Allegheny City, Pa.
W. M. Pannebaker & Co., Lewistown, Pa.

Ventilating Hotels, Restaurants and Kitchens.

S. H. Thompson, Chicago, Ill.
Russell House, Detroit, Mich.
Plankinton House, Milwaukee, Wis.
Bemis & Hale, Chicago, Ill.
McCoy's Hotel, Chicago, Ill.
Riggs' House, Washington, D. C.
E. H. Johnson, Chicago, Ill.
Crawford House, Chicago, Ill.
Windsor Hotel, St. Paul, Minn.
Boston Oyster House, Chicago, Ill.
Race Bros., Chicago, Ill.
C. S. Woodman, Chicago, Ill.
Wm. Thompson, Chicago, Ill.
Edmanson Bros., Chicago, Ill.
G. McBride & Devine, Chicago, Ill.
Mrs. Andrews, Chicago, Ill.
Gibson House, Cincinnati, O.
Cosmopolitan Restaurant, Milwaukee, Wis
Hotel Lafayette, Philadelphia, Pa.
Carrollton House, Baltimore, Md.
T. D. Cook, Boston, Mass.
Wissahickon Inn, Chestnut Hill, Philadelphia, Pa.
Willoughby, Hill & Co., Chicago, Ill.
H. C. Stewart, Cincinnati, O.
Morris Hotel, St. Louis, Mo.
Planters Hotel, St. Louis, Mo.
Moser Hotel, St. Louis, Mo.
Revere House, Boston Mass.
John Pearce, London, Eng.
Smith & McNeil, New York City.
Holtz & Koennicke, New York City.
M. F. Lyons, New York City.
Manhattan Hotel, New York City.
Powers' Hotel, Rochester, N. Y.
H. Luehrmann, Memphis, Tenn.
Hotel Buchtel, Akron, O.
Arcade Hotel, Springfield, O.
W. F. Richter, New York City.
Jones' Restaurant, New York City.
S. & J. Davis, Orange, N. J.
John Lavery & Co., New York City.
Mitchell Building Restaurant, Milwaukee, Wis.
J. B. Martin, Cincinnati, O.
Earnest Kohlsaat, Chicago, Ill.
St. Lawrence Hall, Montreal, Can.
Cook's Restaurant, Boston, Mass.
Boston & Providence R. R. depot, Boston, Mass.
R. Marston & Co., Boston, Mass.
New York Catering Co., New York City.
The Hoffman Restaurant, N. Y. City.

Ventilating Groceries, Bakeries and Candy Factories.

P. Eckert & Co., Cincinnati, O.
P. F. Bryce, Indianapolis, Ind.
C. Jevne, Chicago, Ill
W. H. Aldrich & Co., Chicago, Ill.
Franklin MacVeagh & Co., Chicago, Ill.
E. J. Acosta, Jr., Savannah, Ga.
R. Oven's Bakery, Buffalo, N. Y.
California Cracker Co., San Francisco, Cal.
Corle Cracker & Confectionery Co., Kansas City, Mo.
W. G. Wilson, Philadelphia, Pa.
Dozier & Weil Cracker Co., St. Louis, Mo.
C. D. Boss & Son, New London, Ct.
Hawley & Hoopes, New York City.
Henry Heide, New York City.
Meiggs & Trott, Waterbury, Ct.
Lillibridge Bakery, Minneapolis, Minn.
Mason, Au & Zollinger, Brooklyn, N. Y.
John A. Auger & Bro., New York City.
E. Greenfield & Sons, New York City.
Fobes, Hayward & Co., Boston, Mass.
E. G. Whitman & Co., Philadelphia, Pa.
John Kranz, Chicago, Ill.
Geo. Zeigler, Milwaukee, Wis.
David Carrick & Co., Philadelphia, Pa.
E. J. Hoadley, Hartford, Conn.
L. Schepp, New York City.

Removing Heat and Steam from Sugar Refineries.

Harrison, Havemeyer & Co., Philadelphia, Pa.
McKean, Borie & Co., Philadelphia, Pa.
John Schwartz, London, Eng.
F. O. Matthiessen & Wiechers, Jersey City, N. J.
Brooklyn Sugar Refinery, Brooklyn, E. D., N. Y.
Havemeyer & Elder, Brooklyn, E. D., N. Y.
American Glucose Co., Buffalo, N. Y.
James Duncan, Victoria Docks, E. Eng.
D. Martineau & Son, 6 Christian St., E. Eng.

Removing Heat and Odors from Oil Refineries.

Howard Oil Co., Houston, Tex.
J. V. Lewis & Co., Cincinnati, O.
Atlantic Oil Works, Philadelphia, Pa.

Drying Brick and Pottery.

Purinton-Kimbell Brick Manfg. Co., Chicago, Ill.
Hinchliff & Owens, Hobart, Ind.
East Trenton Pottery Co., Trenton, N. J.
Union Pottery Co., Trenton, N. J.
New Jersey Flint & Spar Co., Trenton, N. J.
G. Defestities, Perth Amboy, N. J.
Pittsburg Clay Pot Co., Pittsburg, Pa.
Johnstown Manufacturing Co., Johnstown, Pa.

Drying of Glue.

Jos. Lister, Chicago, Ill.
Jos. Morrow, Newport, Pa.
Baeder, Adamson & Co., Philadelphia, Pa.
Lister Bros., Newark, N. J.
Hon. Wm. Brown, Peabody, Mass.
W. H. Brown, Peabody, Mass.
J. & G. Cox, Gorgie, Edinburgh, Scotland.
The Gallow Hill Glue Works, Market Harboro', Eng.
Elizabethport Glue Works, Elizabethport, N. J.
George W. Brown, Marblehead, Mass.
F. T. L. Lane, Newark, N. J.
Salem Glue Co., Salem, Mass.
Delaney & Co., Philadelphia, Pa.
Clark, Thackray & Co., Leeds, Eng.
S. Holroyd & Sons, Manchester, Eng.
W. A. Hoeveler, Pittsburg, Pa.
Rohrer & Morrow, Harrisburg, Pa.
Talbot & Tunnell, Philadelphia, Pa.

Removing Steam from Hat Factories.

Hendel, Bobst & Co., Reading, Pa.
J. R. Miller & Co., Reading, Pa.
Howard W. Flagg, Yonkers, N. Y.
Garner & Dudley, Orange, N. J.
Hy. Friedberger, Philadelphia, Pa.
J. E. & W. Christy & Co., Stockport, Eng.
D. Wilcox & Co., Boston, Mass.
Potter Bros., Philadelphia, Pa.

Ventilating and Drying in Paint and Lead Works.

Collier Lead Co., St. Louis, Mo.
Lead & Oil Co., St. Louis, Mo.
F. W. Devoe & Co., New York City.
J. Lee Smith, Brooklyn, N. Y.
Copal Varnish Co., limited, Egham Surrey, Eng.
John Lucas & Co., Philadelphia, Pa.
Brooklyn White Lead Co., Brooklyn, N. Y.
D. F. Treman & Co., New York City.

Ventilating and Drying in Soap Factories.

J. S. Kirk & Co., Chicago, Ill.
Proctor & Gamble, Cincinnati, O.
Chas. McKeone & Sons, Philadelphia, Pa.
N. K. Fairbanks & Co., Chicago, Ill.
J. Haas, St. Louis, Mo.
Colgate & Co., Jersey City, N. J.
D. S. Brown & Co., New York City.
Lautz Bros. Co., Buffalo, N. Y.
W. & H. Walker, Pittsburg, Pa.
A. & F. Pears, Isleworth, Eng.
Ed. Cook & Co., Bow, E. England.
A. Savage & Son, Montreal, Can.
James Armstrong & Co., Baltimore, Md.
Wrigley Manufacturing Co., Philadelphia, Pa.
Day & Frick, Philadelphia, Pa.

Ventilating Tobacco Factories.

C. W. Allen Co., Chicago, Ill.
Wilson & McAllay Tobacco Co., Middletown, O.
Leggett & Meyer Tobacco Co., St. Louis, Mo.
P. Lorillard & Co., Jersey City, N. J.
F. S. Hess & Co., Rochester, N. Y.
Cope Bros. & Co., Liverpool, Eng.
Kerbs & Spiess, Tobacco, New York City.

Drying Tobacco.

C. W. Allen Co., Chicago, Ill.
Rudolph Finzer, Louisville, Ky.
John Finzer & Bro., Louisville, Ky.
W. T. Grant & Co., Louisville, Ky.
Louisville Leaf Tobacco Co., Louisville, Ky.
Weissinger & Bate, Louisville, Ky.
Leggett & Meyer Tobacco Co., St. Louis, Mo.
G. W. Helme, Railroad Mills, N. J.
Monie Bros, New York City.
H. Westcott's Sons & Co., Binghamton, N. Y.
Cope Bros. & Co., Liverpool, Eng.
Musselman Tobacco Co., Louisville, Ky.
Kerbs & Spiess, New York City.
Charles Butler & Co., Binghamton, N. Y.

Ventilating Newspaper, Printing and Electrotype Offices.

J. M. W. Jones' Stationery-Printing Co., Chicago, Ill.
Louisville Courier-Journal, Louisville, Ky.
Brown, Pettibone & Kelly, Chicago, Ill.
J. B. Jeffrey, Chicago, Ill.
Chicago Evening Journal, Chicago, Ill.
Blakely, Marsh & Co., Chicago, Ill.
Detroit Free Press, Detroit, Mich.
Inter-Ocean Publishing Co., Chicago, Ill.
Chicago Tribune, Chicago, Ill.
Philadelphia Times, Philadelphia, Pa.
W. W. Harding, Philadelphia, Pa.
Philadelphia Inquirer, Philadelphia, Pa.
Baltimore Herald, Baltimore, Md.
A. Zeese & Co., Chicago, Ill.
Blomgren Bros. & Co., Chicago, Ill.
Hallock, Chandler & Co., Chicago, Ill.
Russell-Morgan Printing Co., Cincinnati, O.
Penny Press, Cleveland, O.
Mount & Co., Cleveland, O.
A. Mudge & Son, Boston, Mass.
Globe-Democrat Printing Co., St. Louis, Mo.
Buxton & Skinner Printing Co., St. Louis, Mo.
Woodward Printing Co., St. Louis, Mo.
C. G. Burgoyne, New York City.
Boston Herald, Boston, Mass.
New York Daily News, New York City.
David Williams (Iron Age), Press Room, N. Y. City.
Boston Daily Advertiser, Boston, Mass.
Globe Newspaper Co., Boston, Mass.
Bureau of Engraving and Print'g, Washington, D. C.
The Philadelphia Record, Philadelphia, Pa.
Hy. Blacklock & Co., Farringdon Road, E. C., Eng.
A. Kingdon & Co., Moorsfield, E. C., Eng.
New York World, New York City.
George E. Marshall & Co., Chicago, Ill.
George Brander, Milwaukee, Wis.
Montreal Star, Montreal, Can.
Burland Lithographic Co., Montreal, Can.
Cleveland Herald, Cleveland, O.
Chicago Daily News, Chicago, Ill.
Strines Printing Co., Strines, Manchester, Eng.
Schmidt Label Lithograph Co., San Francisco, Cal.

Ventilating Public and School Buildings.

Academy of Music, Chicago, Ill.
State Public School, Coldwater, Mich.
City of Milwaukee Council Chamber, Milwaukee, Wis.
Town of Lake High School, Englewood, Ill.
Merchants' Savings, Loan and Trust Co., Bank, Chicago, Ill.
U. S. Mint, Philadelphia, Pa.
Danvers Lunatic Asylum, Danvers, Mass.
Criterion Theatre, Piccadilly, London, Eng.
N. Y. Produce Exchange, New York City.

U. S. Treasury Building, Bureau of Engraving and Printing, Washington, D. C.
Municipal Court Room, Milwaukee, Wis.
Board of Trade Building, Chicago, Ill.
Central College City and Guilds Institute, South Kensington, Eng.
University College, Edinburgh.
Central Criminal Court, London, Eng.
Finsbury College City and Guilds Institute, City Road, E. C.
New Board Schools, Finchley, Eng.
Kohl & Middleton, Museum, Chicago, Ill.
Columbia, late Haverly's Theatre, Chicago, Ill.
Royal Courts of Justice, Chambers Strand, Eng.
Philadelphia Stock Exchange, Philadelphia, Pa.
Royal Insurance Building, Chicago, Ill.
Pennsylvania Co., for Insurance on Lives, Philadelphia, Pa.
Masonic Temple, Philadelphia, Pa.
Chicago Opera House, Chicago, Ill.
American Museum of Natural History, N. Y. City.
Music Hall, Plainfield, N. J.
New Haven Hospital, New Haven, Conn.
Parker Street Public School, Boston, Mass.
Hammond Street School, Boston, Mass.
Wisconsin State Capital, Madison, Wis.
Philadelphia Post Office, Philadelphia, Pa.
Maryland State House, Annapolis, Md.
John Wanamaker's, Grand Depot, Philadelphia, Pa.
Provident Life & Trust Co., Philadelphia, Pa.

Drying Malt.

Bemis & Carden, Chicago, Ill.
Philip Best Brewing Co., Milwaukee, Wis.
V. Blatz, Milwaukee, Wis.
Bemis & McAvoy Brewing Co., Chicago, Ill.
George C. Langdon, Detroit, Mich.
W. S. Duncan & Co., Detroit, Mich.
Jacob Mann, Detroit, Mich.
Wallace Campbell, Chicago, Ill.
Frank Falk Brewing Co., Milwaukee, Wis.
C. L. Epps & Co., Chicago, Ill.
J. Schlitz Brewing Co., Milwaukee, Wis.
A. V. McKim & Co., Kansas City, Mo.
L. Liebscher, Milwaukee, Wis.
United States Distilling Co., Chicago, Ill.
F. J. Swaine, Ypsilanti, Mich.
F. A. Poth, Philadelphia, Pa.
D. G. Yuengling & Son, Pottsville, Pa.
F. Bergner, Philadelphia, Pa.
Mueller & Co., Cleveland, O.
J. B. Smith, Cleveland, O.
E. Wainwright Brewing Co., St. Louis, Mo.
J. W. Lemp, St. Louis, Mo.
J. Winklemeyer Brewing Co., St. Louis, Mo.
Teuscher Distilling Co., St. Louis, Mo.
Peter Walker & Sons, Warrington, Eng.
J. Kay, Manchester, Eng.
John B. Manning, Buffalo, N. Y.
A. Ziegel & Co., Buffalo, N. Y.
Fisher Bros., Buffalo, N. Y.
Lyon & Mott, Oswego, N. Y.
C. W. Pardee, Oswego, N. Y.
J. S. & W. Brown, Brooklyn, N. Y.
Francis Perot's Sons, Oswego, N. Y.
S. Liebermann's Sons, Brooklyn, N. Y.
George A. Weiss & Co., Chicago, Ill.
Philadelphia Brewery, San Francisco, Cal.
Macklem & Slater, Suspension Bridge, N. Y.
Arnold & Bernheimer, Brooklyn, N. Y.
Chicago Malt & Grain Co., Chicago, Ill.
T. Knapstein & Co., New London, Wis.
August Furmann, Watertown, Wis.
Neidlinger, Schmidt & Co., New York City.
Rosenheim & Strouse, New York City.
Courage & Co., Horsleydown, S. E. Eng.
Barclay Perkins & Co., Southwark, Eng.
Taplin & Sons, Brighton, Eng.
Wm. Kearney, Syracuse, N. Y.
W. D. Matthews, Leroy, N. Y.
John York, Jr., Rose, N. Y.
John F. Dalrimple, Seneca Falls, N. Y.
Wm. Van Marter, Weedsport, N. Y.
P. Ballentine & Sons, Newark, N. J.
J. & H. McKechnie, Canandaigua, N. Y.
W. Seed, Bradford, Eng.
Continental Brewing Co., Philadelphia, Pa.
John F. Betz & Son, Philadelphia, Pa.
Wehr, Hobelmann & Gottleib, Baltimore, Md.
L. J. Kadish, Chicago, Ill.

Ventilating Machine Shops, Metal Works, Etc.

Waterbury Brass Co., Waterbury, Conn.
National Wire and Lantern Works, Brooklyn, N. Y.
G. V. Cresson, Machinery, Philadelphia, Pa.
T. Schriver & Co., Foundry, New York, N. Y.
John Fowler, Plow Works, Leeds, Eng.
E. P. Hampson & Co., Engine Builders, New York, N. Y.
Gibson & Price, Lead Pipe Works, Cleveland, O.
Taylor & Craig, Machinery, St. Paul, Minn.
Benton Waldo & Co., Type Foundry, Milwaukee, Wis.
O'Connor & Werst, Plumbers, Louisville, Ky.
J. C. McNeil, Boiler Maker, Akron, O.
Medart Pulley Co., Machinery, St. Louis, Mo.
Hoopes & Townsend, Bolt and Nut Works, Philadelphia, Pa.
R. F. Bancoft & Son, Blacksmiths, Philadelphia, Pa.
Wentworth Spring & Axle Co., Gardiner, Me.
American Tube Works, Boston, Mass.
American Watch Co., Waltham, Mass.
Howard & Morse, Wire Goods, Brooklyn, N. Y.
Iden & Co., Gas Fixtures, New York, N. Y.
R. Hoe & Co., Printing Presses, New York, N. Y.
E. P. Gleason & Co., Gas Fixtures, New York, N. Y.
Pratt & Litchworth, Hardware, Buffalo, N. Y.
Herring Safe Co., New York, N. Y.
Brand & Co., Stove Manufacturers, Milwaukee, Wis.
Chidester & Mellen, Memphis, Tenn.
R. Wolfertz, Detroit, Mich.
Barbaroux & Co., Louisville, Ky
Detroit Blower Co., Drying Lumber, Detroit, Mich.
Aultmann, Miller & Co., Akron, O.
Schwab & Sercomb, Milwaukee, Wis.
J. H. McGowan & Co., Cincinnati, O.
Bergstrom Bros. & Co., Dust, Neenah, Wis.
Kentucky Machinery Co., Louisville, Ky.
Adams & Westlake Manufacturing Co., Removing Dust, Chicago, Ill.
Robert Mitchell & Co., Removing Dust from Polishers, Montreal, Can.
White Sewing Machine Co., Cleveland, O.
Stanley Works, Acid Fumes, New Britain, Conn.
John A. Roebling's Sons Co., Trenton, N. J.
Carey & Moen, Removing Dust, New York City.
E. Balbach & Son, Newark, N. J.
Cowing & Gleason Manufacturing Co., Seneca Falls, N. Y.
Syracuse Malleable Iron Works, Tumblers, Syracuse, N. Y.
Bussey & McLeod Stove Company, Tumblers, Troy, N. Y.
Jerome & Co., New York City.
Globe Buffer Co., Boston, Mass.
New Haven Wire Co., Acid Fumes, New Haven, Ct.
Cambria Iron Co., Gautier Steel Department, Johnstown, Pa.
Pusey & Jones Co., Wilmington, Del.
H. W. Butterworth & Sons, Philadelphia, Pa.
Reyburn, Hunter & Co., Lightning Rods, Philadelphia, Pa.
Bethlehem Iron Co., Bethlehem, Pa.
H. I. Snell, Philadelphia, Pa.
Daniel Kelly, Philadelphia, Pa.
Enterprise Manufacturing Co., Philadelphia, Pa.
Remington & Co., Wilmington, Del.
Danby & Leigh, Engineers, Hong Kong.
Philip Lindo, Engineer, Rotterdam, Holland.

Drying Lumber.

Symes & Jones, Appleton, Wis.
Kennesaw Manufacturing Co., Memphis, Tenn.
Spalding Manufacturing Co., Hastings, Mich.
Smith & Co., Horton Buck, Eng.
J. Ingleson & Co., Hoboken, N. J.
John Sperry & Co., N. Y. City.
P. W. Casler & Co., Little Falls, N. Y.

Ventilating Agricultural Implement Works.

Dennett Harvesting Machine Co., Removing Smoke, Milwaukee, Wis.
J. I. Case Threshing Machine Co., Removing Dust, Racine, Wis.
J. I. Case Plow Co., Ventilation, Racine, Wis.

Removing Dust from Carpet Cleaners.

Pioneer Carpet Beating Co., San Francisco, Cal.
Bristol Carpet Cleaning Co., Cincinnati, O.
T. M. Stewart, New York City.
T. J. Stewart, Jersey City, N. J.
S. C. Bennett & Co., Pittsburgh, Pa.
Rice Carpet Beating Co., Washington, D. C.
Fuller & Mills, Chicago, Ill.
Simmons & Tullidge, King Cross, N. Eng.
Richards & Co., Nottingham, Eng.
Samuel Walker & Co., Bradford, Eng.
Burnham & Maddocks, Lowell, Mass.
Boyer & Knight, Philadelphia, Pa.
The Wm. McArthur Co., Philadelphia, Pa.
S. M. Shelly, Philadelphia, Pa.

Removing Smoke, Heat and Dust from Coffee and Spice Mills.

Jewett & Sherman Co., Milwaukee, Wis.
Sherman Bros. & Co., Chicago, Ill.
A. H. Pratt, Chicago, Ill.
Thompson & Taylor, Chicago, Ill.
Samuel Doll, Cincinnati, O.
John H. Gause & Co., Cleveland, O.
Samuel Wilde's Sons, New York City.

Ventilating Mines.

Upper Lehigh Coal Co., Upper Lehigh, Pa.
Manufacturers Coal Co., Byesville, O.

Ventilating Vessels.

Jay Gould's Yacht, "Atalanta," N. Y. City, N. Y.
W. Cramp, Ship Builder, Philadelphia, Pa.
The Pusey & Jones Co., Wilmington, Del.

Removing Heat, Etc., from Dynamo Rooms.

Brush Electric Ill. Co., New York City.
United States Ill. Co., New York City.
Worcester Electric Light Co., Worcester, Mass.
Merchants Electric Light Co., Boston, Mass.
The Pusey & Jones Co., Wilmington, Del.
Sperry Electric Plant, Chicago, Ill.
Alleghany Co. Light Co., Pittsburg, Pa.
Philadelphia Post Office, Philadelphia, Pa.

Drying.

A. E. Spencer, Chemicals, Chicago, Ill.
A. M. Collins & Son, Cardboard, Philadelphia, Pa.
P. Woll & Sons, Hair, Philadelphia, Pa.
C. & V. E. Forbes, Dry Plates, Rochester, N. Y.
G. G. Rockwood, Dry Plates, New York City.
Ziegler Bros., Shoes, Philadelphia, Pa.
M. A. Seed & Co., Dry Plates, St. Louis, Mo.
L. Creamers, Dry Plates, St. Louis, Mo.
Ira Parker & Co., Hair, Littleton, N. H.
Charles H. Phillips, Phosphates, New York City.
T. Greenland, Cocoa Matting, Brooklyn, N. Y.
Warsaw Salt Co., Salt, Warsaw, N. Y.
The Cocoannt M'f'g. Co., Cocoanut, N. Y. City.
Wm. E. Johnson, Straw Goods, N. Y. City.
D. Goff & Sons, Mohair, Pawtucket, R. I.
Bird & Champney, Coffee, Guatemala, C. A.
Blair Touragraph & Dry Plate Co.
Goodyear Metallic Rubber Shoe Co., Material for Shoes, Naugatuck, Conn.
San Jose Fruit Packing Co., San Francisco, Cal.
E. W. Gillett & Co., Yeast, Chicago, Ill.
C. W. Miller & Co., Hair, Philadelphia, Pa.
Goodacre & Son, Cocoa Fibre, West Ham., E. Eng.
Suffolk Kindling Wood M'f'g. Co., Boston, Mass.
C. C. Sellers, Fruit, Middletown, Del.
Pioneer Kindling Wood Co., White Haven, Pa.
N. C. Mitchell, Rubber, Philadelphia, Pa.
John Lucas & Co., Paint, Philadelphia, Pa.
G. W. Neidrich & Co., Shoes, Carlisle, Pa.
G. W. Ludlow & Co., Shoes, Chicago, Ill.
Gray, Clark & Engle, Leather, Chicago, Ill.

Removing Dust.

Cincinnati Dessicating Co., Fertilizers, Cincinnati, O.
Ohio Valley Cement Co., Cement, Louisville, Ky.
Saussy, Harmon & Remshart, Millers, Savannah, Ga.
John T. Bailey & Co., Cordage, Philadelphia, Pa.
F. Schumacker, Oat Meal Mills, Akron, O.
D. Oliver & Co., Oat Meal Mills, Chicago, Ill.
Lindell Railway Stables, St. Louis, Mo.
T. Greenland, Cocoa Matting, Brooklyn, N. Y.
Mellen & Co., New York City.
Norton & Co., Millers, Lockport, Ill.
Leroy Payne's Horse Cleaning Stand, Chicago, Ill.
Chas. Jacobus & Sons, Hemp Twine, Cincinnati, O.
Milwaukee Mattress Co., Milwaukee, Wis.
I. N. Topliff, Emery Dust, Cleveland, O.
Cadbury Bros., Cocoa Works, Birmingham, Eng.
J. & T. Walker, Manure Works, Bulwell, Nottingham, Eng.
J. Robins & Co., L'td. Cement, Northfleet, Eng.
W. E. Garrett, Snuff, Philadelphia, Pa.
P. C. Thomson, Lye Grinders, Philadelphia, Pa.
Forbes Lithograph M'f'g. Co., Saving Bronze Powder, Boston, Mass.
J. W. Sykes, Seeds, Chicago, Ill.
Pittsburg Clay Pot Co., Pittsburg, Pa.
S. C. Bennett, Carpet Cleaning, Pittsburg, Pa.
W. G. Bradley, Lime Dust, Philadelphia, Pa.
Griswold Worsted Co., Darby, Pa.

Ventilation in Factories, Workshops, Offices, Etc.

M. Young, Mattresses, Arlington, Ill.
C. D. Gilfillan, St. Paul, Minn.
Cleveland Window Shade Co., Cleveland, O.
Wolverine Car Roofing Co., Detroit, Mich.
J. W. Griswold & Co., Cloak M'f'g. Chicago, Ill.
Crocker Chair Co., Sheboygan, Wis.
A. G. Spalding & Bros., Sporting Goods, Chicago, Ill.
J. H. Schenck & Son, Medicine M'f'g., Philadelphia, Pa.
McCall & Newman, Jewelers, Philadelphia, Pa.
P. Hornigensen, Sausage Factory, Brooklyn, N. Y.
Carl Schultz & Co., Mineral Waters, N. Y. City.
C. M. Morse, Machinery, N. Y. City.
Strawbridge & Clothier, Dry Goods, Philadelphia, Pa.
C. V. Seeley, Engineer, St. Paul, Minn.
W. E. Hooper & Sons, Baltimore, Md.
Bryant & Brown Shoe Co., St. Louis, Mo.
Famous Clothing Co., St. Louis, Mo.
L. Rhoorer, Baking Powder, St. Louis, Mo.
Union Depot, St. Louis, Mo.
Western Match Co., St. Louis, Mo.
Badger Knitting Co., Milwaukee, Wis.
S. M. Moore & Co., Chicago, Ill.
Freeman Manufacturing Co., North Adams, Mass.
His Grace the Duke of Sutherland, Eng.
The Right Hon. the Marquis of Salisbury, Eng.
Fulton & Sons, Glenfield, Paisley.
Petrus, Regout & Co., Glassworks, Maastricht, Holland.
Waste Products Co., L'td., Dashwood House, London, Eng.
Ford Works Co., L'td., Southerland, Eng.

The British Xylonite Co., L'td., Homerston, Eng.
A. R. Reck, Copenhagen, Denmark.
J. Weir, Esq., Madras, India.
Brown Bros., Bankers, New York City.
George W. Ballou, Bankers, New York City.
Aldrick & Millinor, Boston, Mass.
H. W. Jones Manufacturing Co., New York City.
The A. H. Hart Co., New York City.
H. B. Claflin & Co., Dry Goods, New York City.
A. W. Stevens, Barber, Logansport, Ind.
Canada Jute Co., Montreal, Can.
Commercial Safe Deposit Co., Chicago, Ill.
Wm. Butler Duncan, Kitchen and Boiler Room, New York City
A. Lovell & Co., School Books, New York City.
Halsted & Co., Provision Dealers, New York City.
Adams Express Co., New York City.
John T. Wilson, Wilson Building, New York City.
F. Bechstein & Camp, Provision Dealers, N. Y. City.
J. Dickinson & Co , Nash Mills, Hemel, Hempstead, Eng.
C. & J. G. Potter, Hallings, Belgrave & Livesey Foldmills, Over Darwin, Eng.
Y. Trotter & Sons, Chirnside, N. B.
Goodall & Co., Wholesale Stationers, Camden Town, N. W. Eng.
Barrett & Co., Beer Bottlers, Vauxhall, S. W. Eng.
Proctor & Bevigton, Bermondsey, S. E. Eng.
British Alizarine Co., L'td., Silvertown, E. Eng.
Sanderson, Murray & Co., L'td., Galashiels, Eng.
Bryant & May, Fairfield Works, Bow, E. Eng.
Newton Match Works Co., Leeds, Eng.
Wm. Whiteley, Universal Provider, Queens Road, Bayswater, Eng.
Thompson & Morris M'f'g. Co., Islington, N. Eng.
B. & W. Marriner, Greengate Mills, Keighley, Eng.
S. Hollis, L'td., Astley Bridge, Bolton, Eng.
Lord Vernon's Dairy, Sudbury, Derby, Eng.
S. Courtald & Sons, Braintree, Essex, Eng.
John Miller & Co., Aberdeen, Scot.
Wm. Whiteley & Sons, Lockwood York, Eng.
R. Markendale, Hopefield Mills, Salford, Eng.
Hoyle & Jackson, Chamber's Mills, Oldham, Eng.
S. C. Lister & Co., Manningham Mills, Bradford, Eng.
F. Sterner & Co., Lancashire, Eng.
Longworth & Co., Springfield Works, Sharples, Bolton, Eng.
Bennett & Son, Birch Vale Mills, Manchester, Eng.
J. H. Gartside & Co., L'td., Buckton Vale Works, Stalybridge, Eng.
Daintree & Co., Southwark Park Road, S. E. Eng.
Hy. Smith & Co., Dundee, Scot.
Halley Bros., Hackel Makers, Dundee, Scot.
Hy. Walker & Son, Caldrum Works, Dundee, Scot.
J. C. Davis, Rope Works, Bow, E. Eng.
The Gourock Ropework Co., Port Glascow, Scot.
J. G. Bullock & Co., Frenchchurch Ave., E. C. and Rangoon, Burmah.
Laird, Shoeber & Mitchell, Shoe Mfrs., Philadelphia, Pa.
H. Lilly, Lilly Street, Manchester, Eng.
Mr. Erhardt, Time Works, Birmingham, Eng.
Francis Tucker & Co., Candle Works, Kensington, Eng.
Hans Reynold, Manchester, Eng.
J. C. Waterhouse, Wakefield, Eng.
Laird & Co., Preserved Potatoes, Douglas, Isle of Man.
R. W. Thomas & Co., 10 Pall Mall, S. W. Eng.
Knawndupoelella Estate, Matala, Ceylon.
Hon. Wm. Russell, Georgetown, Demerara.
Fabrica Lombardi di Prodotti, Chimici, Milan, Italy.
Clayton & Shuttleworth, Vienna, Austria.
Jacob & Becker, Leipzig, Germany.
Muhr & Co., Philadelphia, Pa.
S. B. & B. W. Fleischer, Dyehou-e, Philadelphia, Pa.
F. & I. Heinz, Pickle Works, Pittsburg, Pa.
P. J. Ritter Conserve Co., Philadelphia, Pa.
John Parker, Surgical Hosiery, Philadelphia, Pa.
Lehigh Valley R. R. Co., South Easton, Pa.
Warner & Merritt, Philadelphia, Pa.
J. D. Thompson, Philadelphia, Pa.
John Mundell & Co , Shoe M'f'g., Philadelphia, Pa.
P. Cox Shoe Co., New York City.
E. B. Mayo, Boston, Mass.
Boston Safe Deposit & Trust Co., Boston, Mass.
Rand, McNally & Co., Office, Chicago, I.l.
George F. Ott, Coppersmith, Philadelphia, Pa.
F. J. Hafner, Philadelphia, Pa.
James E. Caldwell & Co., Philadelphia, Pa.
Paxon, Comfort & Co., Philadelphia, Pa.
S. S. White Dental M'f'g. Co., Philadelphia, Pa.
Jacob Ulmer, Pork Packer, Pottsville, Pa.
Keasby & Mattison, Drug M'f'g., Philadelphia, Pa.
Jacob Gump & Co., Philadelphia, Pa.
Laird, Schober & Mitchell, Philadelphia, Pa.

Applications to Special Work.

Western Refrigerator Co., Circulating Cold Air, Chicago, Ill.
W. Wolstencraft, Removing Steam, Philadelphia, Pa.
Bartell & Co., Pork Packers, Cooling, St. Louis, Mo.
Portland Star Match Co., Sulphur Fumes, Portland, Me.
Wesp, Lautz Bros. & Co., Removing heat and moisture, Buffalo, N. Y
J. L. Kipp, Removing Smoke from Forge Room, N. Y. City.
Erie Preserving Co., Removing Fumes, Buffalo, N.Y.
Oswego Shade Cloth Co., Removing moisture, Oswego, N. Y.
Horace Barber, Removing steam, Warehouse Pt. Conn.
Minetto Shade Cloth Co., Removing fumes, Oswego, N. Y.
J. M. Mason, Removing Steam, Boston, Mass.
John Matthews Co., Removing gas, N. Y. City.
Ontario Straw Goods M'f'g. Co., Removing steam, Toronto, Can.
Gossamer Rubber Co., Removing gas and acid odor, Framingham, Mass.
Standard Cordage Co., Removing tar fumes, Boston, Mass.
E. Sandford & Sons, Removing steam, Amsterdam, N. Y.
Cleveland Bros. Baking Powder, Removing dust, Albany, N. Y.
Halstead & Spencer, Removing smoke, Philadelphia, Pa.
Daubman Bros., & Co., Fertilizing Works, Baltimore, Md.

REMOVAL OF STEAM ETC.—CONTINUED

Bath Rooms.
Blood Drying.
Cotton Mills.
Cloth Spongers.
Cardboard Mills.
Curled Hair Factories.
Corn Dryers.
Canneries.
Candle Factories.
Cement Works.
Candy Factories.
Dining Rooms.
Drying Rooms.
Dye Houses.
Desicating Rooms.
Dry Kilns.
Engine Rooms.
Foundries.
Felt Factories.
Glue Works.
Hat Factories.
Hide Drying Rooms.
Kitchens.
Laundries.
Leather Makers Est.
Lead Works.
Lye Grinders.
Lead Oil Works.
Meal Houses.
Mattress Makers.
Malt Floors.
Newspaper Offices.
Oil Refineries.
Oil Cloth Works.
Paper Mills.
Paper Bag Factories.
Packing Houses.
Phosphate Works.
Pickel Works.
Restaurants.
Round Houses.
Silk Mills.
Shirt Factories.
Sugar Refineries.
Soap Factories.
Slaughter Houses.
Starch Factories.
Sizing Rooms.
Salt Drying.
Sponging Rooms.
Shoddy Mills.
Tobacco Factories.
Tallow Factories.
Tobacco Steamers.
Vinegar Works.
Wall Paper Factories.
Woolen Mills.
Wool Pullers.
Window Shade Factories.
Water Closets.
Wool Dyeing.
Wool Dryers.
Wash Rooms.
Yeast Factories.
Yarn Dyeing Houses.
Yarn Drying.

REMOVAL OF HEAT, ODORS, FOUL AIR FROM

Bakeries.
Breweries,
Brass Foundries.
Boiler Shops.
Bolt and Nut Works.
Blacksmith Shops.
Butcher Shops.
Baking Powder Mills.
Boiler Rooms.
Barns.
Barber Shops.
Bronze Powder Mills.
Billiard Halls.
Basements.
Bath Rooms
Cotton Mills
Confectioners' Kitchens.
Composing Rooms.
Car Shops.
Coffee Roasters.
Cars.
Candle Factories.
Club Houses.
Car Barns.
Candy Factories.
Dynamo Rooms.
Dining Rooms.
Dry Good Houses.
Dye Houses.
Desicating Rooms.
Dime Museums.
Electrotyping Rooms.
Engine House.
Exchanges.
Exposition Buildings.
Foundries.
Forge Rooms.
Fertilizers.
Felt Makers.
Fish Stores.
Fish Oil Factories.
Grocery Stores.
Glue Works.
Glass Works.
Hair Curlers.
House Cleaning.
Hospitals.
Hide Drying.
Jails
Kitchens.
Laundries.
Lead Works.

REMOVAL OF HEAT, ETC.—CONTINUED.

Livery Stables.
Lavatories.
Lard Oil Factories.
Labaratories.
Match Mackers.
Museums.
Newspaper Offices.
Oil Refiners.
Packers.
Phosphate Factories.
Pork Packers.
Press Rooms.
Prisons.
Restaurants.
Railroad Shops.
Round Houses.
Silk Mills.
Shirt Factories.
Sugar Refineries.
Spice Grinders.
Soap Makers.
Ships.
Steamboats.
Stables.
Slaughter Houses.
Sizing Rooms.
Snuff Makers.
Sewers.
Stereotyping Rooms.
Tobacco Factories.
Type Foundries.
Toilet Rooms.
Tallow Factories.
Urinals.
Vaults.
Vinegar Works.
Water Closets.
Wash Rooms.
Yeast Makers.
Yachts.

REMOVAL OF DUST.

Boards of Trade.
Bakeries.
Baking Powder Factories
Barns.
Bronze Powder Mills
Billiard Halls.
Buffing Rooms
Carpet Cleaners.
Cocoa Matting.
Club Houses.
Car Barns.
Dry Goods Houses.
Dry Plate Works.
Desicating Rooms.
Dusters.
Exchanges.
Emery Wheels.
Exposition Buildings
Fertilizer Factories
Flour Mills.
Grist Mills.
Grinding Rooms.
Hay Cutters.
Horse Cleaning.
Hemp Works.
Halls.
Livery Stables.
Lye Grinders.
Laboratories.
Mills.
Museums.
Newspaper Offices.
Polishers.
Press Rooms.
Rag Cutters.
Silk Mills.
Spice Dealers.
School Rooms.
Stud Cleaning.
Stables.
Starch Works.
Snuff Makers,
Shoddy Mills.
Tobacco Factories.
Tumblers.
Toy Factories.
Woolen Mills.
Window Shade Works.
Wood Pulp Factories.
Wood Engravers.
Yeast Makers.

REMOVAL OF SMOKE FROM

Blacksmith Shops.
Coffee Roasting.
Foundries.
Forge Rooms,
Kitchens.
Laboratories.
Mines.
Railroad Shops.
Round Houses.
Spice Manufacturers.
Sulphur Works.
Singe Houses.
Tobacco Houses.

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